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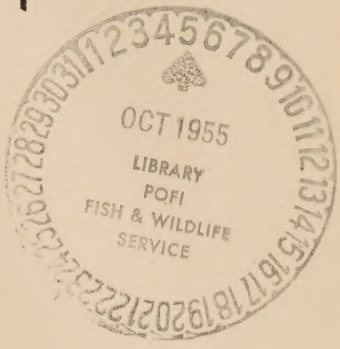

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A Revision of the Japanese Fishes of the Family Platycephalidae (The Flatheads)

By

KIYOMATSU MATSUBARA and AKIRA OCHIAI

KYOTO

MEMOIRS OF THE COLLEGE OF AGRICULTURE

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A Revision of the Japanese Fishes of the Family Platycephalidae (The Flatheads)

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With 4 Tables, 33 Text-figures and 3 Plates

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Contents

I. Introduction 2
II. Material and method of taking counts and measurements 3
III. Acknowledgments 3
IV. Comparative anatomy 4
A. External 4
1. Ocular cirrus 4
2. Iris lappet 4
3. Interopercular flap 6
4. Scales in lateral line 7
B. Internal 14
5. Dentition 14
6. Gill-raker 20
7. Suborbital bones 23
8. Suspensorium and opercular apparatus 28
9. Hyoid apparatus 35
10. Cranium 38
11. Shoulder girdle 45
12. Pelvic girdle 47
13. Alimentary canal and pyloric coeca 49
V. General consideration 50
1. Some adaptational significance found in the Platycephalidae and its related forms 50
2. Position of the Platycephalidae among Loricati 51
3. Differentiation among the Platycephalidae 54
VI. Taxonomy 65
1. Key to Subfamilies and genera of Platycephalidae 65
2. Genus *Onigocia* JORDAN and THOMPSON 68
3. Genus *Rogadius* JORDAN and RICHARDSON 72
4. Genus *Suggrundus* WHITLEY 75
5. Genus *Inegocia* JORDAN and THOMPSON 78
6. Genus *Cociella* WHITLEY 85
7. Genus *Kumococius*, new. 89
8. Genus *Ratabulus* JORDAN and HUBBS 94
9. Genus *Platycephalus* BLOCH 98

1. Introduction

The members of the family Platycephalidae, usually called flatheads, are of wide distribution throughout Indo-Pacific region. They are essentially sluggish bottom-dwellers, spending most of their time on sea-floor of shallow or moderately deep waters not far from the shore. Some of them are valuable food fishes and very popular in the local markets of southern Japan mainly for the domestic consumption.

The actual first revision of the Japanese flatheads was made in 1908 by JORDAN and RICHARDSON. In this study 7 species were placed in 4 genera without giving any subfamilies. In 1919 a new species was added by TANAKA. This family was again revised in 1925 by JORDAN and HUBBS, who placed these 8 known species in 8 genera and assigned to 4 subfamilies. In 1931, however, these 8 species were placed by TANAKA in 3 genera, 2 of them are monotypic. In 1952 another species was added by KAMOHARA as new to the fauna of Japanese water. TANAKA's classification has since been accepted by some Japanese ichthyologists (KURODA, 1931; KAMOHARA, 1938 and 1952 etc.), while this has not been followed by many ichthyologists. Thus, there is no concert of opinions among ichthyologists respecting the taxonomy of this group. In addition to this fact, because the previous studies have been superficial, we were still far from a complete understanding of their relationships. Fortunately, we procured from Japan a rather large number of specimens identical with 9 species aforementioned and another forgotten species. In order to clarify the status and relationships of these species more satisfactorily, comparative study has been undertaken mainly based upon the internal features. In the comparative study the ocular cirrus, iris lappet, interopercular flap, lateral line scale, dentition, gill-raker, suborbital bones, suspensorium, opercular apparatus, hyoid apparatus, cranium, shoulder girdle, pelvic girdle, and alimentary canal were particularly taken into consideration.

By the present comparative study of these species from a viewpoint of anatomy the relationships between various species in question have become evident, and we arrived at a conclusion that it is proper to recognize 8 genera and 10 species assigned in 3 subfamilies. Following is a list of systematic categories, ranging from subfamilies to species, arranged in the new scheme:

Subfamily Onigociinae JORDAN and HUBBS
  Genus *Onigocia* JORDAN and THOMPSON
    Onigocia macrolepis (BLEEKER)
    Onigocia spinosa (TEMMINCK and SCHLEGEL)
  Genus *Rogadius* JORDAN and RICHARDSON
    Rogadius asper (CUVIER and VALENCIENNES)
Subfamily Inegociinae JORDAN and HUBBS
  Genus *Suggrundus* WHITLEY

Suggrundus meerdervoorti (BLEEKER)
Genus *Inegocia* JORDAN and THOMPSON
Inegocia japonica (TILESIUS)
Inegocia guttata (CUVIER and VALENCIENNES)
Genus *Cociella* WHITLEY
Cociella crocodila (TILESIUS)
Genus *Kumococius* MATSUBARA and OCHIAI
Kumococius detrusus (JORDAN and SEALE)
Genus *Ratabulus* JORDAN and HUBBS
Ratabulus megacephalus (TANAKA)
Subfamily Platycephalinae
Genus *Platycephalus* BLOCH
Platycephalus indicus (LINNAEUS)

II. Material and method of taking counts and measurements

The present study is based upon extensive material taken from the following localities, mostly by means of deep-sea trawlers : Choshi, Chiba Prefecture ; Maisaka, Shizuoka Prefecture; Owashi, Mie Prefecture; Osaka; Onomichi, Hiroshima Prefecture; Urado, Kochi Prefecture; Saheki Bay, Oita Prefecture; Nobeoka, Miyazaki Prefecture; Niigata, Niigata Prefecture ; Uozu, Toyama Prefecture ; Kanaiwa, Ishikawa Prefecture ; Obama, Fukui Prefecture ; Maizuru, Kyoto Prefecture ; Taiza, Kyoto Prefecture ; Kasumi, Hyogo Prefecture; Tsuiyama, Hyogo Prefecture; Hamada, Shimane Prefecture; Tomioka, Kumamoto Prefecture ; and East China Sea.

The counts and measurements of various parts of the body were made in the same way as those made by the senior author on his study on the scorpaenoid fishes of Japan (MATSUBARA, 1943, pp. 6–7). We have carefully observed scales, gill-rakers and endoskeleton stained by alizarin red and cleared by potassium hydroxide.

III. Acknowledgments

The writers here wish to express their sincere gratitude to Dr. Tokiharu ABE, Mr. Henry W. FOWLER, Dr. Toshiji KAMOHARA and Mr. Ian S. R. MUNRO for their valuable informations in connection with the present investigation. The writers are also greatly indebted to Messrs. Ichiro FURUKAWA, Reizo ISHIYAMA, Toshiharu KONADA and Kazunori TAKAGI for assistance in obtaining material. Expenses for the present work were defrayed from 1943 to 1945 from a research fund contributed by Mr. Keizo SHIBUSAWA and since 1948 from the grant-in-aid by the Ministry of Education.

IV. Comparative anatomy

A. External

1. Ocular cirrus

The ocular cirrus, which is often called as cirrose lappet, is present only in two species, *Onigocia macrolepis* and *O. spinosa*, in 10 species of the flatheads treated here. The organ is found on lower part of the skin covering the upper part of the cornea, and is opposite to the iris lappet. In these 2 species the organ is rather variable in the shape and even in the extension, but generally much longer than wide and the distal margin is deeply incised. The 2 species is, moreover, so much alike each other in general form of this organ that it may probably be impossible to distinguish them on the basis of the external characteristics alone of this organ, although the distal margin appears to be more deeply notched in *Onigocia spinosa* than in the other one. The possession of this organ, however, may probably be predicated as one of the characteristics of the genus *Onigocia*.

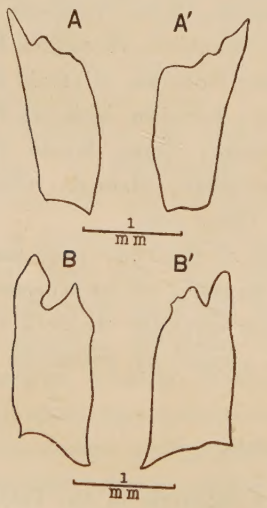

Fig. 1. Lateral view of the ocular cirrus in 2 species, *Onigocia macrolepis* (A·A') and *O. spinosa* (B·B') A and B, right side; A' and B', left side. Drawn by authors.

2. Iris lappet

In the majority of the flat-headed fishes inhabiting in the sea-bottom the upper part of the pupil is furnished with the modification of the extension of the iris lying under the cornea. The covering of the iris, which is proposed to call herein as iris lappet*, shows marked differences in the different species. Of this organ, nevertheless, little attention has been drawn to the taxonomy of the fishes. JORDAN and RICHARDSON, however, paid attention to the presence or absence of this organ in their revision of the Japanese flatheads (1908, p. 630). Through the present study we recognized that the degree of development and the general form of this organ may serve at least for the delimitation of the genera and further may probably throw light on the relationships

* The iris lappet is distinct from the ocular cirrus or the cirrose lappet on the skin lying above the cornea on upper part of the eye. In life or in the fresh condition prior to the preservation in formalin the iris lappet is mostly bright golden-yellow in color, but changes progressively from purplish blue to bluish black after the preservation in formalin and sometimes even becomes obscure. Frequently the lappet is indistinct by folding inward.

or the phyletic significance, although the shape and extension of this organ are more or less variable in some species. On this basis we confirmed 4 types of the iris lappet, thus :

Type 1 (Fig. 2, A–D).— In this probably mostly primitive type, the iris lappet is simply overlying the pupil and neither bilobed nor cirrose. In *Ratabulus megacephalus* (Fig. 2, A) the lappet is scarcely developed. The pupil is, therefore, nearly circular in shape. In *Kumococius detrusus* and *Cociella crocodila* (Fig. 2, B-C) the lappet is closely related to that of *Ratabulus megacephalus*, but much larger and semicircular in shape, leaving a crescent pupil below it. In *Platycephalus indicus* (Fig. 2, D) the organ is much narrower than in the former ones and bluntly pointed at the tip.

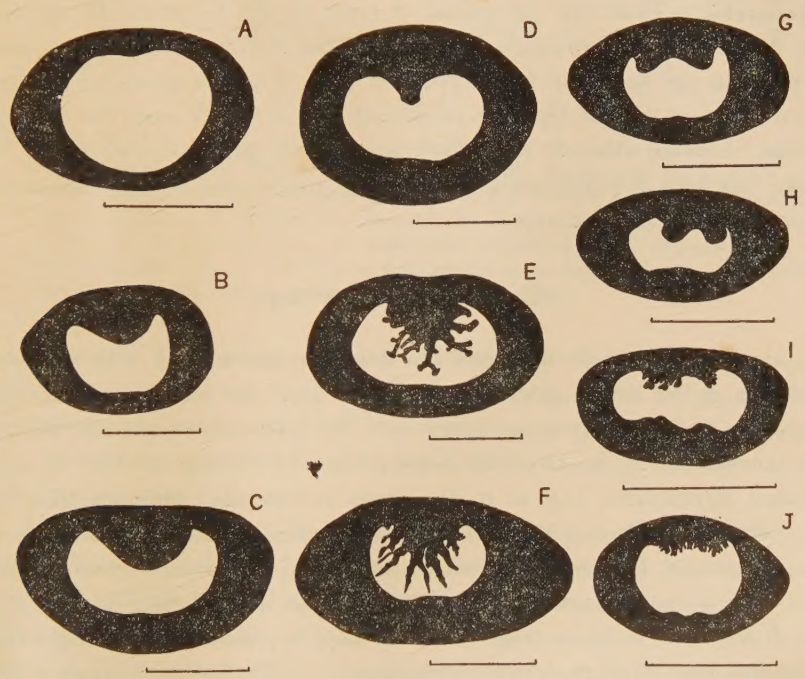

Fig. 2. The eye on right side of the body in 10 species of the flatheads, especially showing the general form of the iris lappet. The iris and the iris lappet are black. A, *Ratabulus megacephalus*; B, *Kumococius detrusus*; C, *Cociella crocodila*; D, *Platycephalus indicus*; E, *Inegocia guttata*; F, *I. japonica*; G, *Suggrundus meerdervoorti*; H, *Rogadius asper*; I, *Onigocia spinosa*; J, *O. macrolepis*. The scales each indicates 5 mm. Drawn by authors.

Type 2 (Fig. 2, E–F).—This type is exemplified by 2 species, *Inegocia guttata* and *I. japonica*. Because of the cirrose iris lappet, the organ seemingly differs markedly from the precedent, but is apparently the derivative of it at least in having the single basal part. The cirri are well developed, dichotomous and some of

them nearly reaching the opposite margin of the pupil. The tips of the cirri are rounded in *Inegocia guttata* (Fig. 1, E), but rather sharply pointed in *Inegocia japonica* (Fig. 1, F).

Type 3 (Fig. 2, G–H).— This type is represented by *Suggrundus meerdervoorti* and *Rogadius asper*. The iris lappet is distinctly bilobed, each of which is broadly rounded at the tip and never cirroses.

Type 4 (Fig. 2, I–J).— *Onigocia spinosa* and *O. macrolepis* are included in this type. The iris lappet is bilobed, as is the case with the precedent, and is obviously its derivative. Each lobe is, however, finely cirrose, the cirri are very short and each is far apart from the opposite margin of the pupil. In the shape of this organ no notable difference can be seen between these 2 species.

Remarks.— Thus, we recognized 4 types in iris lappet in 10 species of the Japanese flatheads, but there seems little doubt that 2 evolutionary series, from Type 1 to Type 2 on one hand and from Type 3 to Type 4 on the other, are fundamentally considered so far as the iris lappet is concerned, and it would seem that the superficial resemblance between the 2 specialized species, *Inegocia japonica* and *Onigocia macrolepis*, has been acquired along the different roads—one is from the simple type and the other, from bilobed type.

3. Interopercular flap

In some species of the flatheads the interopercular margin with a membranous flap, which is called herein interopercular flap, near the junction of the subopercle and is opposite to the preopercular spines. The presence or absence of this organ has been considered to be of much consequence by varions authors for specific or even generic significance, but, as to the shape of the flap, little attention has been paid. Of the 10 species treated here, the 5 ones, *Kumococius detrusus*, *Inegocia japonica*, *I. guttata*, *Platycephalus indicus* and *Suggrundus meerdervoorti*, are usually furnished with a conspicuous flap, forming an acute notch behind it (Fig. 3, A–E).

In *Kumococius detrusus* (Fig. 3, A) the flap is pointed, much longer than wide, and prolonged into more or less bayonet-shape. In *Inegocia japonica* (Fig. 3, B) the flap, although longer than wide, is much shorter than the precedent, caniniform, and acutely pointed, but in a specimen (M. F. C. No. 13920) measuring 153.0 mm in standard length the flap is unusually short and blunt at the tip. The flap in *Platycephalus indicus* (Fig. 3, C) is V– shape in general appearance, but much broader than long and bluntly pointed at the tip. It is worthy of special mention that in the specimens at our disposal smaller than 300 mm. in standard length the flap is always yet undeveloped, but the interopercle is forming a shallow notch at the junction of the subopercle. In *Inegocia guttata* (Fig. 3, D) the flap is very large, rather broader than long, rounded at the tip, and tongue-like in general form. In

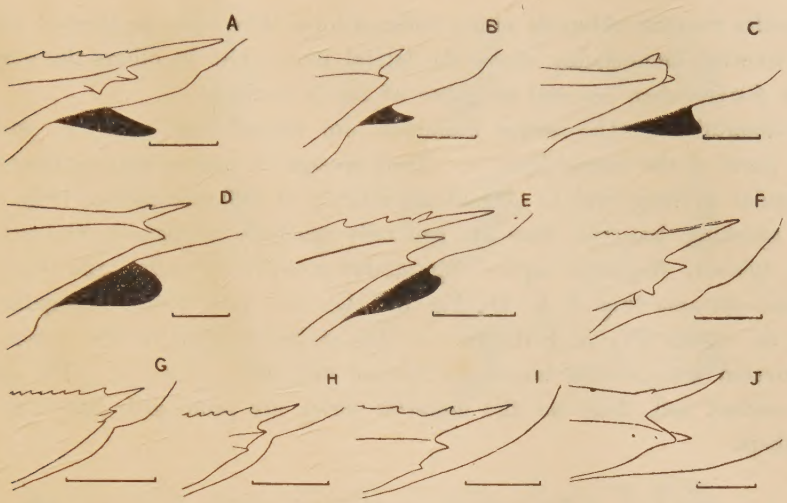

Fig. 3. The outline of the interopercle, subopercle and preopercular spines on left side in 10 species of the flatheads, especially showing the general form of the interopercle and subopercle, and interopercular flap, if present. The interopercular flap is black. A, *Kumococius detrusus*; B, *Inegocia japonica*; C, *Platycephalus indicus*; D, *Inegocia guttata*; E, *Suggrundus meerdervoorti*; F, *Rogadius asper*; G, *Onigocia spinosa*; H, *O. macrolepis*; I, *Ratabulus megacephalus*; J, *Cociella crocodila*. The scales each indicates 5 mm. Drawn by authors.

some specimens of this species the flap is notched so obviously at the tip. In *Suggrundus meerdervoorti* (Fig. 3, E) the flap is also tongue-like in general form, but is approximately 3 times as broad as long and bluntly pointed at the posterior extremity. But in one specimen (M. F. C. No. 15264) measuring 80.0 mm. in standard length the flap is entirely absent.

In *Rogadius asper* (Fig. 3, F), *Onigocia spinosa* (Fig. 3, G), *O. macrolepis* (Fig. 3, H), *Ratabulus megacephalus* (Fig. 3, I) and *Cociella crocodila* (Fig. 3, J) the interopercular flap is entirely absent, but in the former 3 species the interopercle is slightly convex, forming a shallow notch at the junction of the subopercle, while in the others the margins of both interopercle and subopercle are entire. It may be added, however, that in a specimen of *Cociella crocodila* (M. F. C. No. 14719) measuring 325.0 mm. in standard length a shallow notch is found between these 2 bones.

4. Scales in lateral line

The configuration as well as the count of the number of scales are often of some importance in identifying any particular fish. In the present study it was found that there is rather remarkable diversity in configuration of scales in lateral line in the different species. It may also be noticed that in some species the count of the pored scales in lateral line entirely agrees with the number of the transverse

rows of scales running obliquely either backward and downward or forward and downward, if counted immediately above the lateral line, while in others the pored scales are much fewer, when counted in either of the 2 methods.

Configuration. — The scales examined are taken from anterior, middle and posterior parts of the lateral line. They diverge in various degrees from quadrate to rectangular or long oval in general appearance in different species (Figs. 4 and 5). Roughly speaking, however, they are generally quadrate in shape in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper*, *Suggrundus meerdervoorti*, *Inegocia japonica* and *Kumococius detrusus* (Fig. 4, A – D ; Fig. 5, E•G), but vary from rectangular to long ovoid in the others (Fig. 5, F•H•I•J). The posterior parts of the scales are all solidly covered with several transverse rows of tooth-like spines. The spines are basally notched and those on the posterior series are prolonged into more or less bayonet-shape.

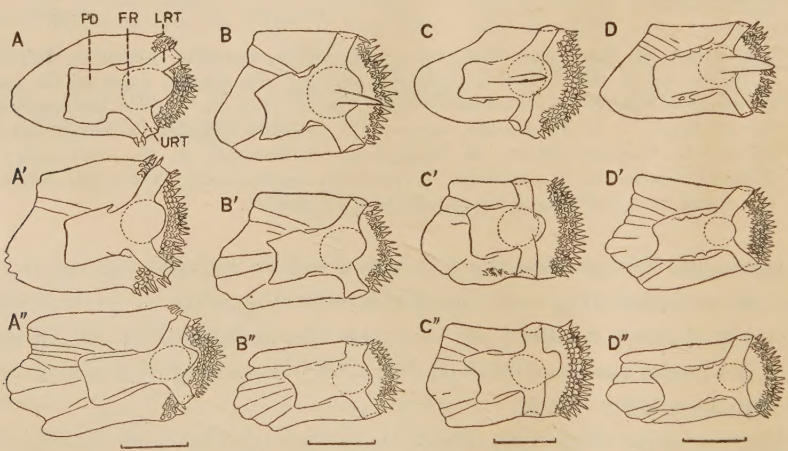

Fig. 4. The outline of the scale on right side of the lateral line in 4 forms, especially showing the general form of the scale and perforating duct. The scale is taken from anterior (A–D), middle (A′–D′) and posterior (A″–D″) parts in the lateral line. A–A″, *Onigocia macrolepis* ; B–B″, *O. spinosa* ; C–C″, *Rogadius asper* ; D–D″, *Suggrundus meerdervoorti*. FR, foramen of perforating duct ; LRT, lower ramified tube ; PD, perforating duct. URT, upper ramified tube. The scales each indicates 1 mm. Drawn by authors.

Perforating duct * is well developed on upper surface along the axis of the scale, communicated with the lateral sensory tube through a large round foramen at the posterior part of the scale. The duct is robust and usually more than half broad as long in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper* and *Suggruudus meerdervoorti* (Fig. 4, A – D), whereas it is rather slender, less than half broad as long in the others (Fig. 5, E – J). It is interesting to note that the duct is communicated

* *Vide* : Cünther, A., 1880b, p. 48.

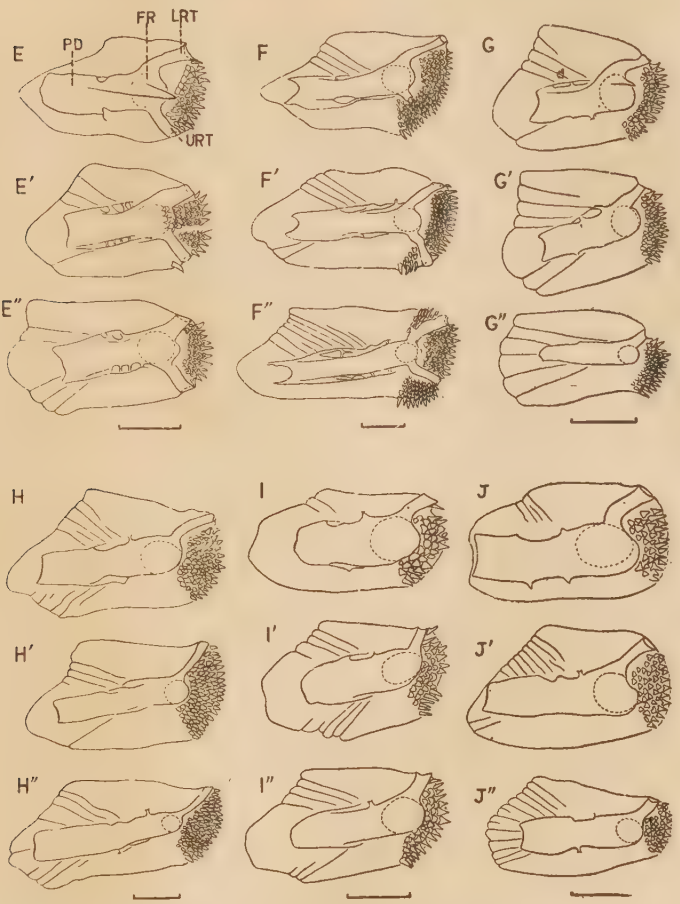

Fig. 5. The outline of the scale on right side of the lateral line in 6 forms, especially showing the general form of the scale and perforating duct. The scale is taken from anterior (E–J), middle (E′–J′) and posterior (E″–J″) parts in the lateral line. E–E″, *Inegocia japonica*; F–F″, *I. guttata*; G–G″, *Kumococius detrusus* H–H″, *Cociella crocodila*; I–I″, *Ratabulus megacephalus*; J–J″, *Platycephalus indicus*. FR, foramen of perforating duct; LRT, lower ramified tube; PD, perforating duct; URT, upper ramified tube. The scales each indicates 1 mm. Drawn by authors.

with the exterior through 2 ramified tubes in *Onigocia macrolepis*,* *O. spinosa*, *Rogadius asper*, *Suggrundus meerdervoorti*, *Inegocia japonica* and *I. guttata* (Fig. 4, A – D; Fig. 5, E – F), and that the upper branch is entirely absent in the others ** (Fig. 5, G – J). In *I. guttata*, however, the upper branch is entirely absent or

* In some specimens of this species the perforating duct in anterior part of the lateral line is ramified sometimes into 3 tubes.

** In *Ratabulus megacephalus* the perforating duct sometimes gives off the upper branch instead of the lower.

rudimentary, if present, in about first 20 scales of lateral line. The branches are usually running backward and outward and opening at the posterior part of the scale except for *Rugadius asper* (Fig. 4, C), in which they usually run directly outward. Further, the branches are very thick in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper* and *Suggrundus meerdervoorti* (Fig. 4, A – D), but rather slender in the others (Fig. 5, E – J).

Count of the scales. — The number of scales in lengthwise series on sides of the body differs sometimes considerably depending on the method of the counting. We, therefore, referred to the count of the scales in 3 cases, thus : 1) pored scales in lateral line, 2) transverse rows of scales running obliquely backward and downward, and 3) same running obliquely forward and downward. The results obtained are shown in Table 1. The count as a whole varies from species to species within a limit of 36 to 69 in the first case [(1) in Table 1], 36 to 112 in the second [(2) in

Table 1. The count of the pored scales in the lateral line (1), transverse rows of scales running obliquely backward and downward (2) and same running forward and downward (3) measured immediately above the lateral line, ratio of (2) to (1), same (3) to (1), and number of spinous scales in lateral line in 10 species of the flatheads. Items put in parenthesis for mean value.

Items / Species	Number of specimens	Pored scaels in lateral line (1)	Transverse rows of scales running obliquely: backward and downward (2)	Transverse rows of scales running obliquely: forward and downward (3)	Ratio of (2) to (1)	Ratio of (3) to (1)	Spinous scales in lateral line
Onigocia spinosa	17	36–38 (36.88)	36–38 (36.88)	36–38 (36.88)	1.00	1.00	8–11 (10.35)
O. macrolepis	33	37–41 (37.97)	37–41 (37.97)	37–41 (37.97)	1.00	1.00	2– 4 (3.00)
Rogadius asper	26	49–53 (51.80)	49–53 (51.80)	58–66 (61.94)	1.00	1.11–1.32 (1.19)	8–12 (8.96)
Suggrundus meerdervoorti	33	50–57 (53.12)	50–57 (53.12)	70–80 (75.48)	1.00	1.30–1.60 (1.40)	8–11 (10.45)
Inegocia japonica	11	51–55 (52.82)	51–55 (52.82)	75–83 (78.18)	1.00	1.42–1.63 (1.48)	6– 8 (7.18)
Kumococius detrusus	20	51–56 (53.50)	51–56 (53.50)	74–83 (78.25)	1.00	1.37–1.63 (1.46)	1– 2 (1.10)
Inegocia guttata	5	50–52 (51.20)	67–76 (72.60)	98–101 (100.00)	1.29–1.49 (1.41)	1.92–2.02 (1.95)	1–3 (1.80)
Ratabulus megacephalus	20	50–56 (52.47)	71–80 (74.15)	95–105 (99.15)	1.32–1.50 (1.41)	1.77–2.06 (1.89)	3–4 (3.20)
Cociella crocodila	22	50–54 (52.50)	79–96 (85.72)	113–126 (119.05)	1.46–1.82 (1.64)	2.19–2.30 (2.27)	2–3 (2.50)
Platycephalus indicus	6	62–69 (65.00)	104–112 (106.60)	121–137 (127.33)	1.60–1.68 (1.65)	1.87–2.05 (1.97)	0

Table 1], and 36 to 137 in the third [(3) in Table 1] respectively.

In *Onigocia spinosa* and *O. macrolepis* the scales are much larger and fewer than in the others, and the count in the 3 cases is quite concordant with each other (See ratio in Table 1). In *Rogadius asper*, *Suggrundus meerdervoorti*, *Inegocia japonica* and *Kumococius detrusus* the scales are moderately large and more numerous than in the precedent; the count in the first 2 cases coincides with each other, but the count in both cases is moderately fewer than that of the third case (See ratio in Table 1). In *Inegocia guttata*, *Ratabulus megacephalus* and *Cociella crocodila* the scales are rather small, and the count of the transverse rows of scales is much larger than in the precedent, and the count in the 3 cases is quite different one another, *viz.*, fewest in the first case, largest in the third case and intermediate of these 2 in the second case; thus the ratio of the count in the third case to first is much larger than in the precedent. In *Platycephalus indicus* the count of the scales in 3 cases also differs greatly each other, but is distinguished from the precedent in having much smaller and more numerous scales.

Thus, we distinguished the Japanese flatheads into 4 groups, so far as the count of the scales is concerned. It should be mentioned that in the members belonging to the last 2 groups the body attains rather enormous size and the scales in lateral line are rectangular or long ovoid in shape, while those of the other group are unexceptionally of dwarf forms and their scales in lateral line are roughly quadrate in general form.

In all the Japanese flatheads except for *Platycephalus indicus* some of the scales in lateral line are each armed with a single spine. As indicated in Table 1, the count of the armed scales varies gradually from species to species within a limit of 1 to 11, and it is by no means constant even within a series of single species.

Remarks. — Summarizing above, 4 species, *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper* and *Suggrundus meerdervoorti* are characterized by 1) scales in lateral line are quadrate in shape, 2) perforating duct is robust, usually more than half broad as long, 3) the duct is communicated with the exterior through the ends of 2 ramified tubes, and 4) the branches of the perforating duct are very thick. This group is, however, distinguished into 2 subgroups by the count of the scales in lengthwise series on sides of the body, involving *Onigocia macrolepis* and *O. spinosa* on one hand, and *Rogadius asper* and *Suggrundus meerdervoorti* on the other. In the first subgroup the scales are much larger and fewer in number than those in the second subgroup, and the count of the pored scales in lateral line agrees exactly with the transverse rows of scales running obliquely backward and downward or forward and downward. In the second subgroup, on the other hand, the scales are smaller and more numerous than in the first subgroup, and the count of the pored scales in lateral line is exactly concordant with the transverse rows of scales running obliquely backward and downward, but much fewer than those running obliquely forward and

downward.

The 3 species, *Cociella crocodila*, *Ratabulus megacephalus* and *Platycephalus indicus*, are characterized by 1) scales in lateral line are roughly rectangular or long ovoid in shape, 2) perforating duct is slender, usually over one-third narrower than its length, 3) perforating duct is lacking in the upper branch, 4) the branch of the perforating duct is slender, and 5) the count of the pored scales in lateral line is much fewer than the transverse rows of scales running obliquely backward and downward, and the latter is also much fewer than the transverse rows of scales running obliquely forward and downward. *Platycephalus indicus*, however, may probably be subgrouped from the others of this group in having much larger number of pored scales in lateral line and transverse rows of scales.

The other 3 species, *Inegocia japonica*, *I. guttata* and *Kumococius detrusus*, are intermediate between these 2 major groups so far as these features are concerned. *Inegocia japonica* is related to *Rogadius asper* and *Suggrundus meerdervoorti* in general form of the scales in lateral line, count of both pored scales and transverse rows of scales, and in having the perforating duct ramified into 2 narrow tubes, but assorts well with *Cociella crocodila* and *Ratabulus megacephalus* in the others. *Inegocia guttata* is much nearer *Cociella crocodila* and *Ratabulus megacephalus* than the others. Indeed, there exist no characteristics which will enable us to distinguish it from them except for having the perforating duct communicated with the exterior through the ends of 2 ramified tubes. But as already noticed in this species, the upper branch is absent or rudimentary, if present, in about first 20 scales in lateral line. *Kumococius detrusus* is well accordant with the first group, especially with *Rogadius asper* and *Suggrundus meerdervoorti*, in general form of the scales in lateral line and the count of both pored scales in lateral line and transverse rows of scales on sides of the body, but goes into second group, especially resembles *Cociella crocodila* and *Ratabulus megacephalus*, in the other peculialities.

After all, these 3 species appear to be the transitional forms between these 2 major groups in various degrees so far as the features of the scales in lateral line are concerned.

Of the 5 items discussed above the third one is of much value above all for the phyletic significance in this group and can be utilized as one of the excellent features of the generic significance, if any.

The presence or absence, or the number, if present, of the armed scales in lateral line has sometimes been considered to be of much account for the generic significance, but, so far as the Japanese flatheads are concerned, it appears to be of little consequence inasmuch as the number is found graduating from species to species within a limit of 1 to 12, and, moreover, a considerable degree of variation is found to exist in a series of single species.

In the taxonomy of the flatheads it is fundamentally important to set forth the

procedure of scale counting in lengthwise series on sides of the body. Because the number of pored scales in lateral line is sometimes much fewer than the count of the transverse rows of the scales, and at the same time the latter is also different sometimes in a great measure according as we count the rows running obliquely backward and downward or we count the rows running obliquely forward and downward. JORDAN and RICHARDSON (1908, pp. 629–642) gave the number of scales as 54 in *Rogadius asper*, 75 in *Thysanophrys meerdervoorti*, 70 to 80 in *T. japonicus*, 90 in *T. crocodilus*, and 120 in *Platycephalus indicus*. Comparing these with our results obtained (Table 1), it may be understood that they gave the count of the transverse rows of scales running obliquely backward and downward in *Rogadius asper* and *Thysanophrys crocodilus*, but did the count of the transverse rows of scales running obliquely forward and downward in the others.

Fig. 6. The band of teeth on left remus of the upper jaw in 5 species of the flatheads examined, especially showing the general form of the teeth and their arrangement. A, *Platycephalus indicus*; B, *Ratabulus megacephalus*; C, *Onigocia sp.nosa*; D, *O. macrolepis*; E, *Rogadius asper*. The scales each indicates 2mm. Drawn by authors.

Fig. 7. Same as in Fig. 6. F, *Suggrundus meerdervoorti*; G, *Kumococius detrusus*; H, *Cociella crocodila*; I, *Inegocia guttata*; J, *I. japonica*. The scales each indicates 2 mm. Drawn by authors.

B. Internal

5. Dentition

The differences in structure correlated with the feeding habit are sometimes untenable for the primary separation of the family into some groups (see, for example, Hubbs and Turner, 1939, p. 11). In Platycephalidae the dentition is unexceptionally developed on the jaws, vomer, palatines and pharyngeal bones, and the general form of the teeth and their arrangement are not so illogical for the primary separation of this family inasmuch as the classification so made is considered to be conformable rather well with the evident lines of phylogenetic relationship.

Teeth on upper jaw: — In all the platycephalids examined the upper jaw is armed with a broad band of the fine teeth (Figs. 6 and 7). The band, however, becomes abruptly narrower at about the anterior one-sixth of it in *Platycephalus indicus* and *Ratabulus megacephalus* (Figs. 6, A-B). The inner side of the band is moderately or deeply incised at about the anterior one-third to one-fourth of it in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper*, *Suggrundus meerdervoorti*, *Kumococius detrusus*

and *Cociella crocodila* (Fig. 6, C·D·E; Fig. 7, F·G·H), but entire in the others. The presence or absence and the degree of development, if present, of the notch, however, can not be considered to be of importance for the taxonomy of this group inasmuch as these features vary rather extensively even within the same species. The teeth of this jaw are mostly granular in shape except for those of the innermost rows, where the teeth are pointed either sharply or bluntly. In *Inegocia japonica*, however, the teeth are mostly granular except the several pointed teeth at the anterior part of the innermost series. Further, in *Platycephalus indicus* the 2 teeth at the anterior part of the innermost series are especially enlarged into bayonet-shape. In *Ratabulus megacephalus*, moreover, the teeth at the anterior part of the band and those of the middle part of the innermost series are canine-like and some of them are even depressible.

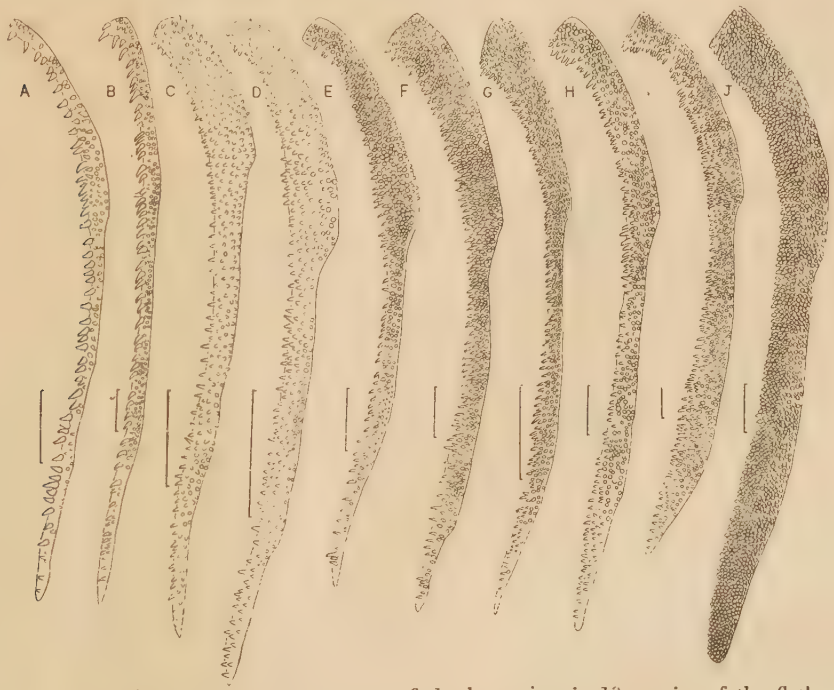

Fig. 8. The band of teeth on right ramus of the lower jaw in 10 species of the flatheads examined, especially showing the general form of the teeth and their arrangement. A, *Platycephalus indicus*; B, *Ratabulus megacephalus*; C, *Onigocia spinosa*; D, *O. macrolepis*; E, *Rogadius asper*; F, *Suggrundus meerdervoorti*; G, *Kumococius detrusus*; H, *Cociella crocodila*; I, *Inegocia guttata*; J, *I. joponica*. The scales each indicates 2mm. Drawn by authors.

Teeth on lower jaw: — The teeth on lower jaw are also placed in a band although much narrower than that of the upper jaw (Fig. 8). The band is lacking in the incision on the inner side, but becomes abruptly narrower at about the anterior

one-fourth to two-fifths of it except for that of *Platycephalus indicus* and *Ratabulus megacephalus* (Fig. 8, A•B), where the band becomes slightly narrower at about the anterior one-third of it. The band in these 2 species is much narrower than that of the other ones, set irregularly into 2 or 3 series in *Platycephalus indicus*, 3 or 4 series in *Ratabulus megacephalus* and more than 6 series in the others. In *Onigocia spinosa* and *O. macrolepis* the teeth are more sparsely arranged than in the others (Fig. 8, C•D). The teeth forming the innermost 1 or 2 series are pointed, but the others are mostly granular in shape and some of them with the cutting edge. In *Inegocia japonica* the inner teeth are much blunter than those of the other species (Fig. 8, J). In *Platycephalus indicus* and *Ratabulus megacephalus* the teeth of the innermost series are much larger and stronger than those of the other species and more or less canine-like in general appearance (Fig. 8, A•B).

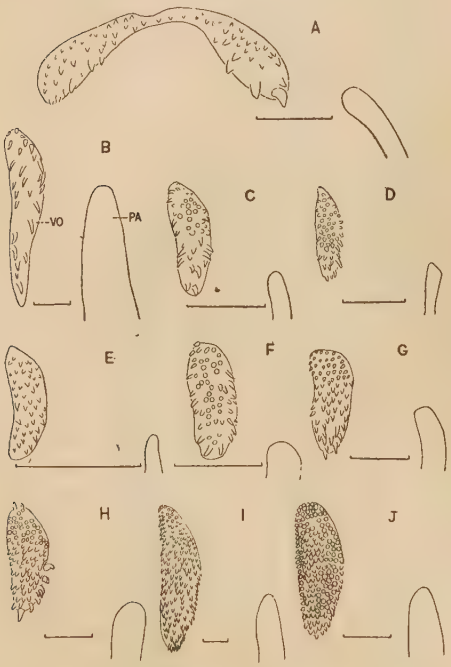

Fig. 9. The band of vomerine teeth (left band in B to J) in 10 species of the flatheads, especially showing the general form of the teeth and their arrangement, and position of the band in relation to the palatine band (right band). PA., palatine band; VO, vomerine band. A, *Platycephalus indicus*; B, *Ratabulus megacephalus*; C, *Rogadius asper*; D, *Kumococius detrusus*; E, *Onigocia macrolepis*; F, *O. spinosa*; G, *Suggrundus meerdervoorti*; H, *Cociella crocodila*; I, *Inegocia guttata*; J, *I. japonica*. Scales each showing 2mm. Drawn by authors.

Vomerine teeth : — As already known (Jordan and Richardson, 1908, pp. 640–641; Jordan and Hubbs, 1925, p. 286) *Platycephalus indicus* is peculiar in having the vomerine teeth set in a crescentic band, which is placed nearly transversely to the shaft of the bone (Fig. 9, A), whilst in the others they are placed in 2 parallel longitudinal bands* (Fig. 9, B–J). The teeth are either villiform or granular in shape, but those in *Ratabulus megacephalus* and *Rogadius asper* (Fig. 9, B•C) are canine-like, and several ones of the innermost series in *Platycephalus indicus* (Fig. 9, A) are especially enlarged. The teeth are placed sparsely in *Platycephalus indicus*, *Ratabulus megacephalus* and *Rogadius asper* (Fig. 9, A–C), thickly in *Cociella crocodila*, *Inegocia guttata* and *I. japonica* (Fig. 9, H–J), and

* Jordan and Hubbs (1925, p. 285) observed that 2 bands are jointed together anteriorly in 1 specimen of *Inegocia japonica*. We also examined such an unusual specimen in the same species.

Fig. 10. The left palatine band of teeth in 10 species of the flatheads examined, especially showing the general form of the teeth and their arrangement. A, *Platycephalus indicus*; B, *Rogadius asper*; C, *Kumococius detrusus*; D, *Onigocia macrolepis*; E, *O. spinosa*; F, *Suggrundus meerdervoorti*; G, *Cociella crocodila*; H, *Inegocia guttata*; I, *I. japonica*; J, *Ratabulus megacephalus*. Scales each indicates 2mm. Drawn by authors.

intermediately in the others (Fig. 9, D – G). The teeth are usually set in a broad band, but 3 series in *Ratabulus megacephalus* (Fig. 9, B) and in a single series at the middle part of the band in *Platycephalus indicus* (Fig. 9, A).

Palatine teeth : — Palatine teeth are lying outside the vomerine band, the insertion of the band being opposite to the posterior extremity of it in *Platycephalus indicus*, anterior one-third of it in *Ratabulus megacephalus*, about middle of it in *Suggrundus meerdervoorti*, and behind the middle of it in the others (Fig. 10). They are set in 2 rows in *Platycephalus indicus* * and *Rogadius asper* (Fig. 10, A, B), but in a band in the others (Fig. 10, C – J). The band is very narrow in *Kumococius detrusus* (Fig. 10, C), very broad in *Ratabulus megacephalus* (Fig. 10, J), and their intermediate in the others (Fig. 10, D – I). It becomes gradually wider posteriorly in *Kumococius* and *Onigocia* (Fig. 10, C – E), but gradually narrower posteriorly in the others (Fig. 10, F – J). The teeth are usually placed sparsely or rather thickly, but very thickly in *Cociella crocodila*, *Inegocia guttata* and *I. japonica* (Fig. 10, G – I). They are little specialized, fine villiform in *Kumococius*

* Jordan and Richardson (1908, pp. 640-641) and Jordan and Hubbs (1925, p. 286) considered to be uniserial in *Platycephalus*.

detrusus, *Onigocia macrolepis*, *O. spinosa*, *Suggrundus meerdervoorti*, *Cociella crocodila* and *Inegocia guttata* (Fig. 10, C – H), granular in *I. japonica* (Fig. 10, I), but prominent in *Platycephalus indicus*, *Rogadius asper* and *Ratabulus megacephalus* (Fig. 10, A•B•J). In *Platycephalus indicus* the inner teeth are enlarged, while those of the outer series are minute, pointed and scarcely visible without an aid of lens. In *Rogadius asper* the teeth are all uniformly large, sharply pointed and more or less canine-like. In *Ratabulus megacephalus* the teeth on anterior half of the palatine and those on anterior two-thirds of the lateral parts of it are especially enlarged into canines, but those on the other parts, are minute as in the outer teeth in *Platycephalus indicus*.

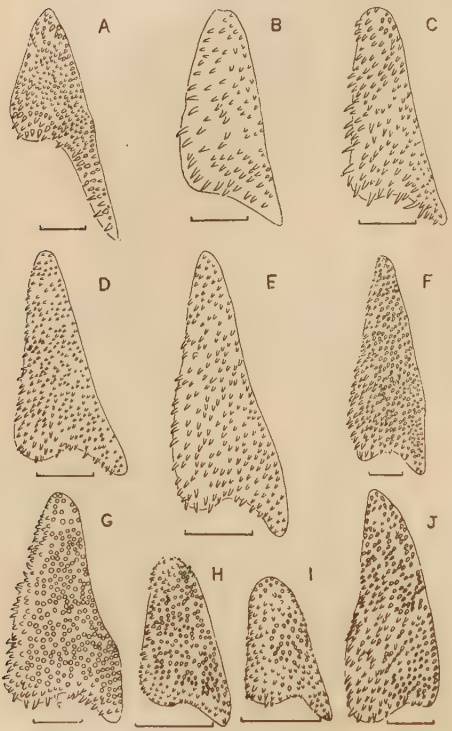

Fig. 11. The right lower pharyngeal teeth in 10 species of the flatheads examined, especially showing the general form of the teeth and their arrangement. A, *Platycephalus indicus*; B, *Ratabulus megacephalus*; C, *Rogadius asper*; D, *Kumococius detrusus*; E, *Suggrundus meerdervoorti*; F, *Cociella crocodila*; G, *Inegocia japonica*; H, *Onigocia macrolepis*; I, *O. spinosa*; J, *Inegocia guttata*. Scales each indicates 2mm. Drawn by authors.

Pharyngeal teeth : — The pharyngeal bones are studded with fine teeth essentially similar, both in form and arrangement, to those on jaws, vomer and palatines.

The lower pharyngeal bones are each armed with triangular band of teeth (Fig. 11). The band is bluntly pointed at the anterior extremity, but broadly bilobed posteriorly ; the outer lobe is usually longer than the inner one except for *Inegocia guttata*, in which the inner lobe is broader and longer than the outer one (Fig. 11, J). *Platycephalus indicus* is peculiar in having much longer outer lobe, which is just as long as the rest of the band (Fig. 11, A). The band is usually much narrower than half the length of it, but in *Inegocia japonica*, *Onigocia macrolepis* and *O. spinosa* (Fig. 11, G – I) it is much broader, about half as broad as long.

The teeth on lower pharyngeal bones are usually no more than close-set, villiform denticles, but those in *Ratabulus megacephalus* (Fig. 11, B) are sparsely placed and those in *Ratabulus megacephalus* and *Rogadius asper* (Fig. 11, B•C) are specialized into more or less canine-like ones. In *Inegocia japonica*, moreover, they are mostly granular in shape, but sharply pointed teeth are seen only on both inner and posterior margins of the band (Fig. 11, G). They

Fig. 12. The left upper pharyngeal teeth in 10 species of the flatheads examined, especially showing the general form of the teeth and their arrangement. A, *Ratabulus megacephalus*; B, *Rogadius asper*; C, *Inegocia guttata*; D, *Onigocia spinosa*; E, *O. macrolepis*; F, *Suggrundus meerdervoorti*; G, *Platycephalus indicus*; H, *Kumococius detrusus*; I, *Cociella crocodila*; J, *Inegocia japonica*. Scales each indicates 2mm. Drawn by authors.

are mostly directed backward and inward, but some ones on the outer margin are pointed directly backward.

The teeth on upper pharyngeals are grouped into 3 patches on each side (Fig. 12). Roughly speaking, the anteriormost patch is rectangular or quadrangular, the mibble one is triangular, and the hindmost one is ovoid in shape. The middle patch becomes narrower inwardly, but the hindmost one is usually broader anteriorly. The teeth in all of the species except for *Ratabulus megacephalus*, *Rogadius asper*, *Cociella crocodila* and *Inegocia japonica* are small, sharp and villiform. They are larger and more or less canine-like in *Ratabulus megacephalus* and *Rogadius asper* (Fig. 12, A-B), rather stout and blunt in *Cociella crocodila* (Fig. 12, I), and stout and mostly granular in *Inegocia japonica* (Fig. 12, J). The teeth are sparsely placed in *Ratabulus megacephalus*, *Rogadius asper*, *Onigocia spinosa*, *O. macrolepis*, *Suggrundus meerdervoorti* and *Platycephalus indicus* (Fig, 12, A-B-D-E-F-G), but they are rather

closely studded in the others (Fig. 12, C·H·I·J). They are mostly directed backward and outward, but those on the inner part are usually pointed backward and inward.

Remarks.— As described above, the dentition shows various degrees of differentiation in the flatheads examined. The family may presumably be aligned into 4 types on the basis of these differences. In *Onigocia*, *Suggrundus*, *Kumococius*, *Cociella* and *Inegocia* the teeth are either villiform or granular in shape, forming a broad band on jaws, vomer, palatines and pharyngeals. But, in *Kumococius* the palatine band is much narrower than in the others, and in *I. guttata* the inner posterior lobe of the lower pharyngeal patch of teeth is enlarged, which is quite contrary to the case with the other genera.

In *Rogadius*, which represents second type, the teeth on jaws are typical with those of these generalized forms, but those on the vomer, palatines and pharyngeals are specialized into canine-like teeth and the palatine teeth are studded with 2 rather well defined parallel rows.

Compared with these genera, *Ratabulus*, which represents third type, is peculiar in having much stronger, more or less depressible canines on jaws, vomer, palatines and pharyngeals, much narrower band on lower jaw, in which the teeth of the innermost series are much larger than those of the outer series, and the band on upper jaw becomes abruptly narrower at about the anterior one-sixth of it.

The last type, *Platycephalus*, resembles *Ratabulus* in having narrow band of teeth on lower jaw, in which the teeth of the innermost series are greatly enlarged, and the band on upper jaw becomes rather abruptly narrower at about the anterior one-sixth of it. The genus, however, has the several peculialities, thus : vomerine teeth are studded in a crescentic band, which is placed nearly transversely to the shaft of the bone ; 2 teeth at the anterior part of the innermost series on upper jaw are especially enlarged into a bayonet-shape ; palatine armed with 2 series of the teeth, the inner teeth are heavy and stout, while those of the outer series are minute ; and the outer posterior part of the lower pharyngeal patch is produced into a long lobe, which is about as long as the rest of the patch.

6. Gill-raker

The count and relative length of the gill-raker have been devoted in identifying any particular fish. In the members of this group the outer surface of the first branchial arch is armed with both club-shaped gill-rakers and discal tubercles. The former lies along the angular region of the arch, but the latter extends throughout the entire length of the arch including the angular region and distal parts of both upper and lower limbs. In the present part we made a comparative study of these organs both qualitatively and quantitatively in 10 species treated here. In this case the

raker at the angle of the arch is enumerated as that of the lower limb.

The gill-raker is stout, more or less tapering and bluntly pointed at the tip; the base is usually truncated, but always trilobated in one at the angle of the arch. The inner surface of the gill-raker is armed with prickles, which are small and numerous in *Kumococius detrusus*, *Onigocia macrolepis*, *O. spinosa*, *Inegocia japonica* and *Suggrundus meerdervoorti* (Fig. 13, A·B·C·E·I), but larger and fewer in the others (Fig. 13, D·F·G·H·J).

The gill-raker on the upper limb is 2 or 3 in *Platycephalus indicus* (Fig. 13, H), constantly 2 in *Kumococius detrusus* (Fig. 13, A), and always 1 in the others. The count on the lower limb varies from species to species within a limit of 3 to 10, and it is not always constant even within a species (Table. 2). But it is found that the 10 species treated here may be grouped into 5 classer in number of gill-rakers on the lower limb by taking the modal number of variation: it is mostly 4 in *Onigocia*; 5 in *Inegocia*; 6 in *Rogadius* and *Cociella*; 7 in *Ratabulus*; and 8 in *Suggrundus*, *Kumococius* and *Platycephalus*.

Table 2. The frequency distribution in number of gill-rakers on lower limb of the first arch in 10 species of Platycephalidae. The mode of the variation is shown by the gothicized number.

Species \ Number	3	4	5	6	7	8	9	10
Onigocia spinosa	2	**19**	2					
O. macrolepis	8	**64**	2					
Inegocia japonica			**20**					
I. guttata			**6**					
Rogadius asper				**26**	11			
Cociella crocodila	1	1	5	**35**	2			
Ratabulus megacephalus				4	**13**	3		
Suggrundus meerdervoorti					13	**84**	26	1
Kumococius detrusus				1	9	**34**	6	
Platycephalus indicus				1	3	**6**	2	

The discal tubercles, which are densely prickled, are usually uniserial on distal parts of both upper and lower limbs, but those on the angular region vary rather extensively in size, number and mode of arrangement, by which the Japanese flatheads may be classified into a number of groups. In the first group represented by *Kumococius*, *Onigocia* and *Inegocia* they are usually uniserial and interpolated between

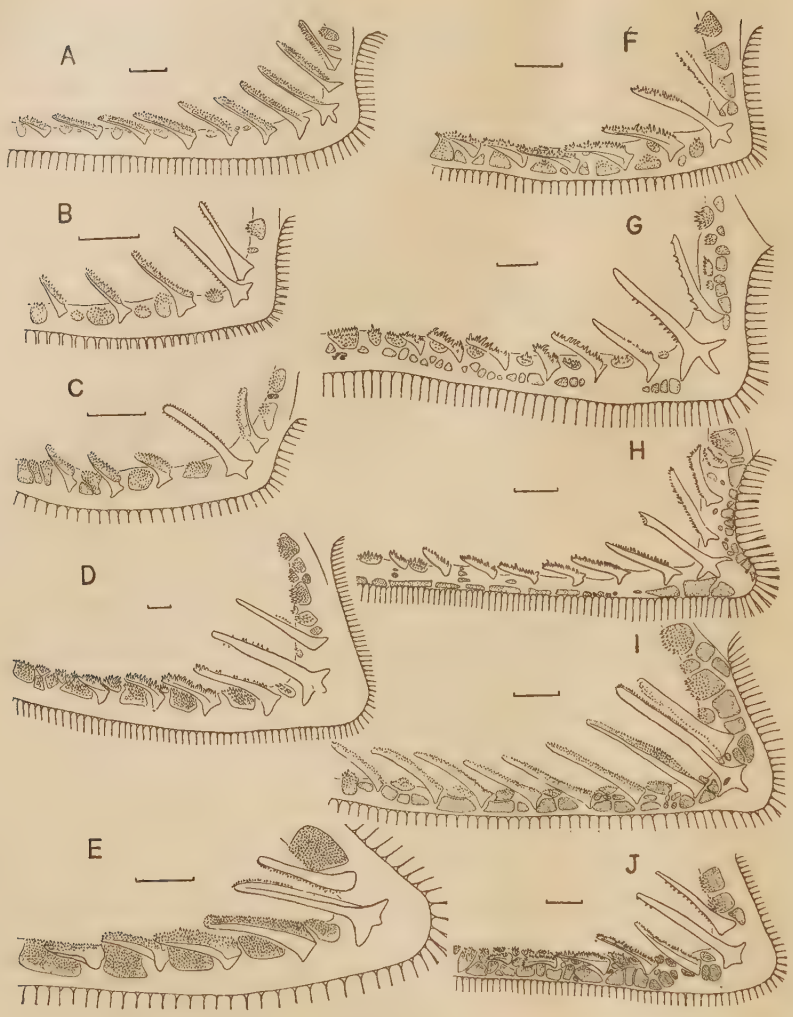

Fig. 13. Angular region of outer face of first gill-arch in 10 species of Platycephalidae. A, *Kumococius detrusus*; B, *Onigocia macrolepis*; C, *O. spinosa*; D, *Inegocia guttata*; E, *I. japonica*; F, *Rogadius asper*; G, *Ratabulus megacephalus*; H, *Platycephalus indicus*; I, *Suggrundus meerdervoorti*; J, *Cociella crocodila*. The scales each indicates 2mm. Drawn by authors.

gill-raker. In *Kumococius* (Fig. 13, A), however, they are very small, lying along the upper ridge of the arch and scarcely visible without the aid of the lens. While those in *Onigocia* (Fig. 13, B•C) are moderately large, and those in *Inegocia* (Fig. 13, D•E) are exceedingly enlarged.

In the second group involving *Rogadius*, *Ratabulus* and *Platycephalus* the

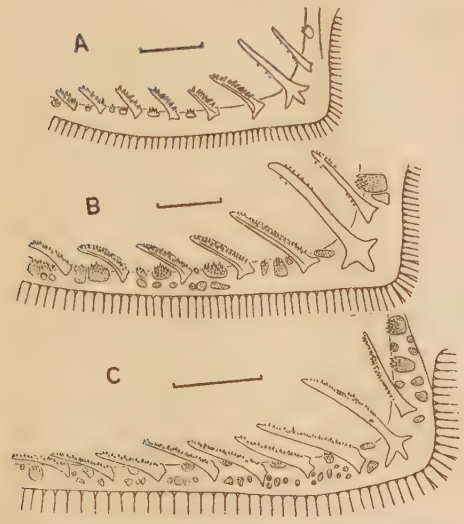

Fig. 14. Angular region of outer face of first gill-arch in youngs of *Ratabulus megacephalus* (A), *Cociella crocodila* (B) and *Suggrundus meerdervoorti* (C). A, 111mm. in standard length (134mm. in total length); B, 132mm. (155mm.); C, 88mm. (105mm.). The scales each indicates 2mm. Drawn by authors.

tubercles are usually set irregularly into 2 series. The tubercles are large and interpolated between gill-rakers in *Rogadius* (Fig. 13, F), but they are small and those on the outer series run along the outer side of base of gill-rakers in *Ratabulus* (Fig. 13, G), and along base of gill-lamella in *Platycephalus* (Fig. 13, H). In *Platycephalus* the tubercles on inner series are rudimentary and irregular in arrangement, usually absent between rakers near the angle of the arch. It should be mentioned that the tubercles on outer series are entirely absent in the young specimen of *Ratabulus* measuring 111mm. in standard length (134mm. in total length) (Fig. 14, A).

In the third group exemplified by *Suggrundus* and *Cociella* (Fig. 13, I-J) the tubercles are large, lying irregularly in 2 or 3 series, and thickly invest the interspaces between gill-rakers. In young specimens, however, the tubercles are very small, rather widely spaced with each other, lying in 2 series in *Cociella* measuring 132mm. (155mm. in entire length) in standard length and in 2 or 3 series in *Suggrundus* measuring 88mm. (105mm. in total length) in standard length (Fig. 14, B-C).

Remarks. — As indicated above, the interspecific differences in branchial apparatus, which may presumably be regarded as mechanical consequence of differences in the food habit, are rather remarkable in adult that the Japanese flatheads can be identified by these differences alone. It should be mentioned that the branchial apparatus is less armed with discal tubercles in young ones than in adults (Figs. 13 and 14). From this ontogenetic evidence it may not be very far-fetched to interpret the successive changes of the differentiation of the branchial apparatus in order A, B, C and so on as indicated in Fig. 13.

7. Suborbital bones

Despite their rather remarkable divergence of the body structure, the fishes of this family are noticeable in that the bony elements constituting this organ and their arrangement are recognizable essentially to be the same in 10 species treated here

and typical in those of the deep-water scorpaenoid fish, *Sebastolobus macrochir* (GÜNTHER) (MATSUBARA, 1943, pp, 7–28, fig. 5). But the characteristics of these elements and the suborbital sensory canal lead to fairly clear-cut generic distinction, and the classification thus made indicates some important phyletic relationship.

Configuration of the bones : — The organ comprises a preorbital and 4 suborbital bones, surrounding both the lower and hind borders of the eye.

The preorbital bone (PO in Fig. 15) is much larger than the first suborbital bone, and usually longer in the fish with the longer snout. Roughly speaking the bone is rectangular, quadrangular or triangular in shape. The upper head of this bone is thickened and the top concave, forming a rather deep socket for the reception of the lateral head of the prefrontal bone. The upper anterior part of the bone is greatly produced forward and slightly upward, and rather sharply pointed in *Ratabulus megacephalus* and *Platycephalus indicus* (Fig. 15, I•J), but blunt and never especially produced in the others (Fig. 15, A–H). The lower anterior margin of the bone is armed with 2 or 3 antrorse spines in *Onigocia macrolepis* and *O. spinosa* (Fig. 15, A•B), 2 similar but stouter ones in *Ratabulus megacephalus* and *Platycephalus indicus* (Fig. 15, I•J), indefinitely serrated in *Rogadius asper* and *Suggrundus meerdervoorti* (Fig. 15, C•D), but is entire in the others (Fig. 15, D–H).

The upper surface of the preorbital bone is armed with a lengthwise series of close-set sharp shines on posterior half of it in *Onigocia macrolepis* and *O. spinosa* (Fig. 15, A•B), fine granules in *Rogadius asper* and *Suggrundus meerdervoorti* (Fig. 15, C•D), 1 pungent spine at the central part of it in *Suggrundus meerdervoorti*, *Kumococius detrusus*, *Cociella crocodila* and *Ratabulus megacephalus* (Fig. 15, D•E•F•I), but usually smooth in the others (Fig. 15, G–H•J).

The first suborbital bone (ISO in Fig. 15) is rectangular or rhombic in shape, much smaller than the second suborbital bone, and held between the latter and the preorbital bone. This bone is relatively much narrower antero-posteriorly in *Onigocia* (Fig. 15, A•B) than in *Rogadius*, *Suggrundus*, *Kumococius*, *Cociella* and *Inegocia* (Fig. 15, C–H), and intermediate between these 2 groups in *Ratabulus* and *Platycephalus* (Fig. 15, I•J). The anterior border of this bone is overlapped narrowly in *Onigocia*, broadly in the others, with the posterior part of the preorbital. The posterior margin of the bone is conjoined with the anterior border of the second suborbital in *Onigocia*, but the posterior part of the bone is overlapping above the anterior part of the second suborbital bone in the others.

The upper surface of the first suborbital bone is armed with a lengthwise series of about 3 or 4 pungent spines behind those of the preorbital bone but continuing with them in *Onigocia* (Fig. 15, A•B), 2 or 3 distinct spines, larger posteriorly, in *Ratabulus* (Fig. 15, I), 1 pungent spine in *Kumococius*, *Cociella* and *Inegocia* (Fig. 15, E–H), 1 pungent spine and 2 rows of small more or less granular spines in *Suggrundus* (Fig. 15, D), and about 2 or 3 rows of fine granules in *Rogadius* (Fig. 15, C),

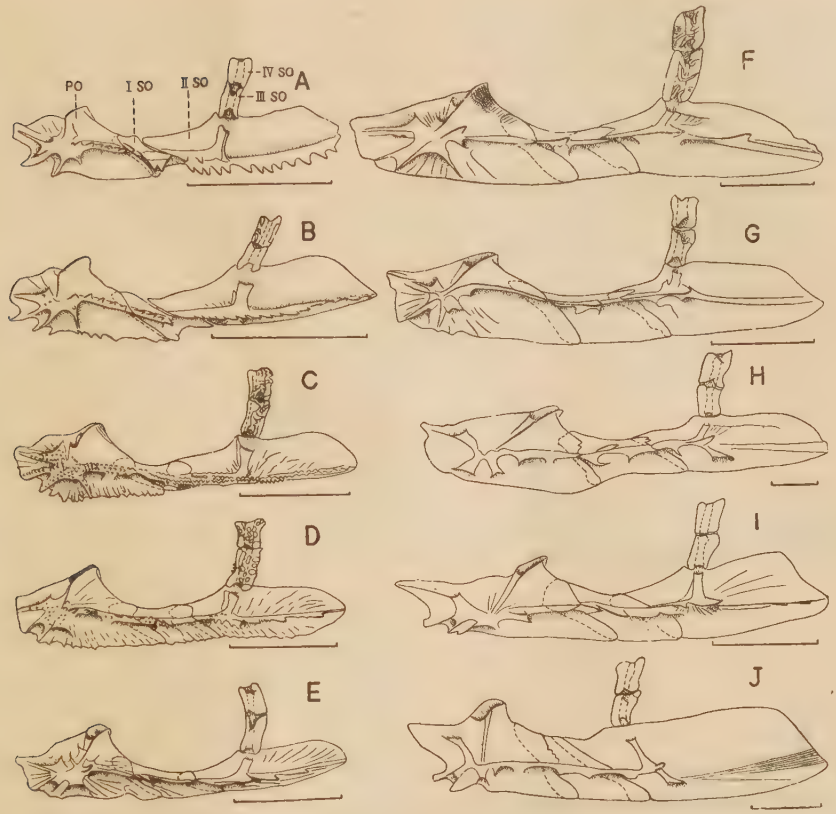

Fig. 15. The outline of the left side of the suborbital bones in 10 species of the flatheads examined. A, *Onigocia macrolepis*; B, *O. spinosa*; C, *Rogadius asper*; D, *Suggrundus meerdervoorti*; E, *Kumococius detrusus*; F, *Cociella crocodila*; G, *Inegocia japonica*; H. *I. guttata*; I, *Ratabulus megacephalus*; J, *Platycephalus indicus*. PO, preorbital bone; ISO, first suborbital bone; IISO, second suborbital bone; IIISO, third suborbital bone; IVSO, fourth suborbital bone. The scales each indicates 10mm. Drawn by authors.

but is entirely smooth in *Platycephalus* (Fig. 15, J).

The second suborbital bone (IISO in Fig. 15) is larger than the other elements of this organ. In characteristics involving the configuration and relationship to the upper ridge of the preopercle this bone is referred to Type S^{BA} in the scorpaenoid fishes (MATSUBARA, 1943, pp. 11–14, fig. 5–7). It is nearly uniformly broad or gradually becoming wider toward the middle of it, and firmly attached to the upper ridge of the preopercle, forming a stout suborbital stay.

The bone is usually flattish and gently raising toward the median longitudinal line, where it is strengthened by a longitudinal keel. The lower border of the bone is mostly exposed as a longitudinal keel on side of the head (Fig. 15, D–J).

While in *Onigocia* and *Rogadius* the lower half of the bone below the median keel is turned inward at right angle, and the lower border of the bone reaches to under side of the head (Fig. 15, A–C). Thus, the side of the head is unicarinate in *Onigocia* and *Rogadius*, but bicarinate in the others, as stated by JORDAN and HUBBS (1925, pp. 285–286).

The median longitudinal keel of this bone is armed with a row of close-set sharp spines in *Onigocia* (spines are fewer and stronger in *macrolepis* than in *spinosa*. Fig. 15, A-B), but about 4 indistinct spines and fine granules in *Suggrundus* (Fig. 15, D), 3 pungent spines in *Kumococius* (Fig. 15, E), 1 or rarely 2 similar spines in *Cociella* (Fig. 15, F), 1 sharp spine and about 4 much smaller ones in *Ratabulus* (Fig. 15, I), 1 sharp spine in *Inegocia* (Fig. 15, G-H), and a blunt tubercle in *Platycephalus* (Fig. 15, J). Both the upper and lower borders are usually smooth except for *Suggrundus*, in which the lower border is irregularly undulated.

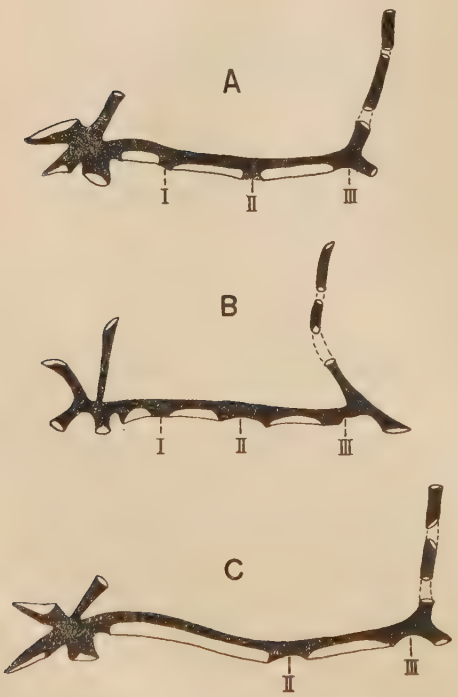

Fig. 16. 3 types of the suborbital sensory canal in the flatheads examined. A, *Suggrundus meerdervoorti*; B, *Platycephalus indicus*; C, *Inegocia japonica*. I, II and III showing respectively the first to third bridge of the bone on the hindmost branch of the sensory canal radiating from the central part of the preorbital bone. Drawn by senior author.

The third suborbital bone (IIISO in Fig. 15) is small, flattened and rectangular in shape. The upper surface of this bone is usually smooth, but roughened by the irregular granules in *Rogadius* and *Suggrundus* (Fig. 15, C-D). It is held by the second suborbital bone, usually at the middle part (Fig. 15, A – I), but in *Platycephalus* nearly at the anterior one-fourth (Fig. 15, J) of the upper border of the latter.

The fourth suborbital bone (IVSO in Fig. 15) resembles the third suborbital bone both in the size and shape and is interpolated between the third suborbital and the sphenotic bone.

The suborbital sensory canal (Figs. 15 and 16) : — The suborbital sensory canal is well developed, hollow out the preorbital and suborbital bones as in Type O^a in the scorpaenoid fish (MATSUBARA, 1943, pp. 16–17, figs. 2–5). It radiates in 5 directions from the central part of the preorbital bone (Fig. 16, A – C) :

the first running upward and backward and opens at the upper head of this bone, the second extends forward and upward; the third opens at the lower anterior part of the bone, the fourth extends vertically downward, and the last runs directly backward. The last branch runs under the median suborbital keel to nearly midway of the second suborbital bone, where it gives off a short branch to the suborbital stay and runs upward through the third and fourth suborbital bones (Fig. 16, A-C). While in *Platycephalus* it gives off a branch at the anterior one-third of the second suborbital bone, then runs upward and forward instead of vertically upward until it reaches to the third suborbital bone (Fig. 16, B). This concides with the fact that the third suborbital is held at about anterior one-fourth, instead of about middle, of the upper border of the second suborbital bone. (Fig. 15, J).

The last branch from the central part of the preorbital bone widely opens, on the preorbital and the first and second suborbital bones. It is bridged over on posterior part of the preorbital bone, anterior or middle part of the first suborbital bone and anterior part of the second suborbital bone in *Rogadius*, *Suggrundus*, *Inegocia guttata* and *Platycephalus* (I, II and III in Fig. 16), while the anteriormost bridge on the preorbital is entirely absent in *Onigocia*, *Kumococius*, *Cociella*, *Inegocia japonica* and *Ratabulus* (Fig. 16, C).

Remarks: — The characteristics of the suborbital bones outlined above display 4 types. In the first type represented by *Onigocia* (Fig. 15, A-B), which is presumably of the most primitive type, the first suborbital bone is very narrow anteroposteriorly and the posterior margin of the bone is conjoined with the anterior border of the second suborbital bone, as is the case with the scorpaenoid fish, instead of being broadly overlapped above the anterior part of the second suborbital; the lower half of the second suborbital bone below the median longitudinal keel is turned inward at right angle, and the lower border of the bone reaches to the under side of the head, thus, the side of the head is unicarinate as in the scorpaenoid fish; the median longitudinal keel on the preorbital and the anteriormost two suborbital bones are armed with a row of close-set sharp spines; the lower anterior margin of the preorbital bone is armed with 2 or 3 sharp antrorse spines; the hindmost branch of the suborbital sensory organ is not bridged over on posterior part of the preorbital bone (Fig. 16, C).

In the second type (Fig. 15, D-I), which involves *Suggrundus*, *Kumococius*, *Cociella*, *Inegocia* and *Ratabulus*, the first suborbital bone is moderately broad anteroposteriorly, broadly overlapping above the anterior part of the second suborbital bone; the lower half of the second suborbital bone below the median longitudinal keel is never turned inward, and the lower margin of this bone is exposed as a longitudinal keel on the side of the head, thus, the side of the head is bicarinate; the median longitudinal keel on the preorbital and the anteriormost 2 suborbital bones are not armed with a row of close-set sharp spines; the lower anterior margin of the preorbital

bone without distinct antrorse spines except for *Ratabulus*, in which the bone is provided with 2 stout antrorse processes.

The suborbital bones of the genus *Rogadius* (Fig. 15, C), which represent third type, can not be referred to either of these 2 main types, for it combines some of the features of each. The lower half of the second suborbital bone below median longitudinal keel is turned inward, as is the case with the first type. The first suborbital bone, however, is moderately broad antero-posteriorly, broadly overlapping above the anterior part of the second suborbital bone as in the second type. The median longitudinal keel on the preorbital and the anteriormost 3 suborbital bones are armed with 2 or 3 rows of the fine granules; the lower anterior margin of the preorbital bone is indefinitely serrated; the hindmost branch of the suborbital sensory organ is bridged over on the posterior part of the preorbital bone.

The organ of the genus *Platycephalus* (Fig. 15, J), which represents the fourth type, essentially agrees well with that of the second type, but cannot be referred to it. In this genus, the upper surface of this organ is entirely smooth except for having a blunt tubercle on anterior part of the second suborbital bone; the third suborbital bone is held at the anterior one-fourth of the upper border of the second suborbital bone instead of being nearly middle of it; the hindmost branch of the suborbital sensory canal gives off a branch at the anterior one-third of the second suborbital bone, then runs upward and forward, instead of being vertically upward, until it reaches to the third suborbital bone; the lower anterior margin of the preorbital bone armed with 2 stout antrorse spines; the upper anterior arm of the preorbital bone is produced into a conical process; the hindmost branch of the suborbital sensory organ from the central part of the preorbital bone is bridged over on the posterior part of the bone.

Thus, we referred the suborbital bones of the Japanese flatheads into 4 types, yet the second one shows marked differences: In *Suggrundus* (Fig. 15, D) the upper surface of the preorbital and the median keel on the preorbital and the anteriormost 2 suborbital bones are finely granulated though less than in *Rogadius*, the lower anterior margin of the preorbital bone is indefinitely serrated; in *Suggrundus* and *Inegocia guttata* (Fig. 15, D-H) the hindmost branch of the suborbital sensory organ from the central part of the preorbital is bridged over on the posterior part of the bone. But in *Kumococius*, *Cociella*, *Inegocia japonica* and *Ratabulus* (Fig. 15, E-F-G-I) the said bridge is entirely absent; in *Ratabulus* (Fig. 15, I) the upper anterior arm of the preorbital bone is produced into a conical process and lower anterior margin of the preorbital bone with 2 stout antrorse processes as in *Platycephalus* (Fig. 15, J).

8. Suspensorium and opercular apparatus

The bony elements constituting these organs and their general arrangement are

exactly the same in the 10 species treated here, and generally typical in those of the scorpaenoid fishes (MATSUBARA, 1943, pp. 28–43, figs. 8–15), but the configuration

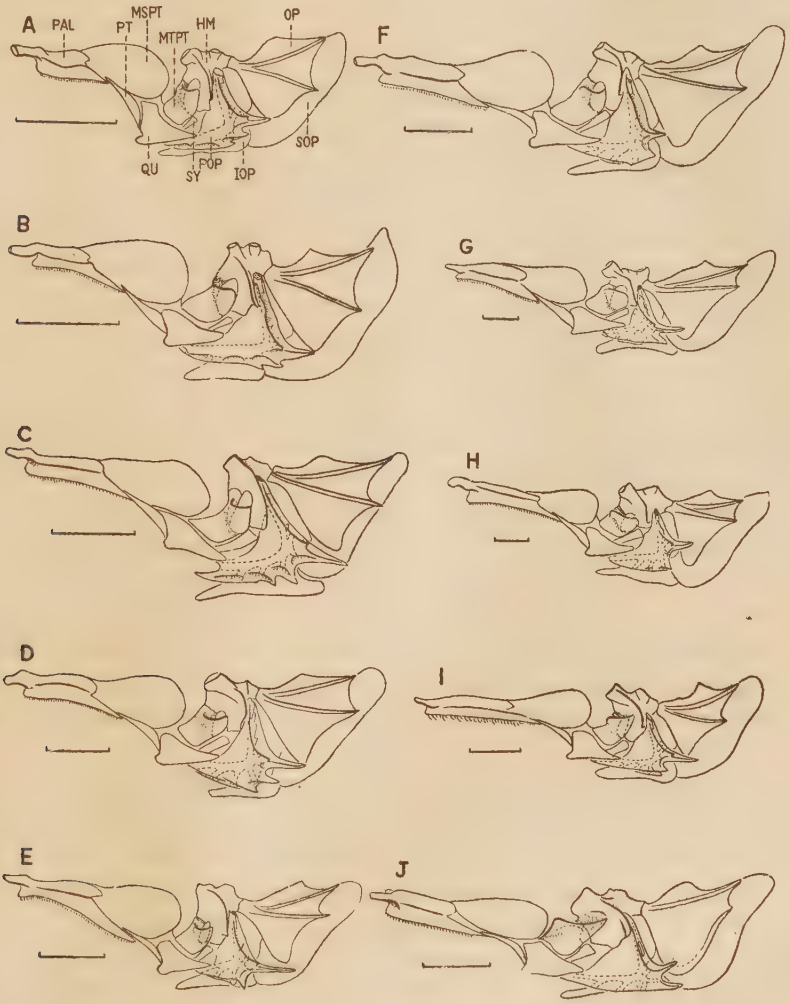

Fig. 17. The outline of the left side of the suspensorium and opercular apparatus in 10 species of the flatheads, especially showing hyomandibular, metapterygoid and mesopterygoid bones, interosseous space between hyomandibular process and metapterygoid lamina, preopercular spines, preopercular sensory canal and opercular keels. HM, hyomandibular bone, IOP, interopercle; MSPT, mesopterygoid bone; MTPT, metapterygoid bone; OP, opercle; PAL, palatine; POP, preopercle; PT, pterygoid; QU, quadrate; SOP, subopercle; SY, symplectic bone. A, *Onigocia spinosa*; B, *O. macrolepis*; C, *Rogadius asper*; D, *Suggrundus meerdervoorti*; E, *Kumococius detrusus*; F, *Inegocia japonica*; G, *Cociella crocodila*; H, *Inegocia guttata*; I, *Ratabulus megacephalus*; J, *Platycephalus indicus*. The scales each indicates 10mm. Drawn by authors.

of the hyomandibular, metapterygoid and mesopterygoid bones, number and figures of preopercular spines, general form of the preopercular sensory canal, and the presence or absence of the lower opercular keel shows sometimes marked differences in the present 10 species.

Configuration : — The hyomandibular bone (Fig. 17, HM) is generally rectangular in shape, with a stout process, which is called hyomandibular process (MATSUBARA, 1943, p, 29), extending downward and slightly forward to the upper head of the symplectic bone. The process is very broad, short and indistinct in *Platycephalus indicus*, but moderately long and distinct in the others, as is the case with the generalized scorpaenoid fishes.

The metapterygoid bone (Fig. 17, MTPT) is also rectangular or quadrate in shape, and throws out a delicate flat wing of bone, which is called the metapterygoid lamina (MATSUBARA, 1943, p. 29), from inner surface of the bone upward to the lower anterior margin of the hyomandibular bone and closely fit to it, leaving an oblong interosseous space between it and the lateral side of the hyomandibular process. The metapterygoid lamina is very inconspicuous in *Platycephalus indicus*, but it is moderately or very long in the others. The interosseous space between metapterygoid lamina and hyomandibular process is entirely covered with the posterior extension of the metapterygoid bone in *Platycephalus indicus* and *Ratabulus megacephalus*, but about one-third of the space is not covered by the same bone in the other 8 species. The upper half of the metapterygoid bone in *Platycephalus indicus*, but the posterior half of the bone in the others, is turned outward. Thus, the configuration of the metapterygoid bone is particular in 2 species, *Platycephalus indicus* and *Ratabulus megacephalus*, as is the case with the specialized scorpaenoid fishes.

The mesopterygoid bone (Fig. 17, MSPT) is very thin and ovoid or ellipsoid in general appearance, as is the case with the generalized scorpaenoid fishes. The longitudinal diameter of the bone is much longer than the palatine measured to upper posterior end of the bone in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper*, *Suggrundus meerdervoorti* and *Platycephalus indicus*, but about as long as it in *Kumococius detrusus*, *Inegocia japonica* and *Cociella crocodila*, and much shorter than it in *Inegocia guttata* and *Ratabulus megacephalus*. Generally speaking, the degree of development of the mesopterygoid bone has much to do positively with the size of the eye-ball.

The number and configuration of the preopercular spines have been served to assist greatly the taxonomy of this group. As an important feature of the genus *Rogadius*, JORDAN and RICHARDSON (1908, p. 630) stated as, "a stout antrorse spine on lower face of the preopercle and 3 spines at the angle." In the present careful examination of *Rogadius asper* another rudimentary spine is found to exist immediately before the third spine from the upper and directed backward and down-

ward as in 3 spines at the angle (Figs. 17, C and 18, A). Thus, the preoperculum of this fish is armed with 5 spines, as is the case with the generalized scorpaenoid fish, although the anteriormost and hindmost ones are especially prolonged into a bayonet-shape. 3 conspicuous preopercular spines are unexceptionably present in *Onigocia spinosa*, *O. macrolepis* and *Suggrundus meerdervoorti* (Figs. 17, A·B·D and 18, B·C·D), the uppermost one is enlarged and directed backward, but the other ones backward and slightly downward. 2 conspicuous spines and a rudimentary one are present in *Kumococius detrusus*, *Inegocia japonica*, *I. guttata*, *Cociella crocodira* and *Ratabulus megacephalus* (Figs. 17, E·F·G·H·I and 19, E·H·G·I·F). The uppermost one is especially prolonged into a bayonet-shape in *Kumococius detrusus*, *Cociella crocodila* and *Ratabulus megacephalus*, but slightly longer than the second one in *Inegocia japonica* and *I. guttata*. The second spine from the upper is directed downward in *Kumococius detrusus*, but backward and slightly downward in the others. The third spine from the upper, which is scarcely visible without an elimination of the skin, is rudimentary in *Inegocia japonica* and *I. guttata* and very frequently absent in the adult specimens of *Cociella crocodila*; it is directed backward and slightly downward in *Ratabulus japonicus* and *Cociella crocodila*, but directed downward in the others. The preopercular spines are always 2 in number in

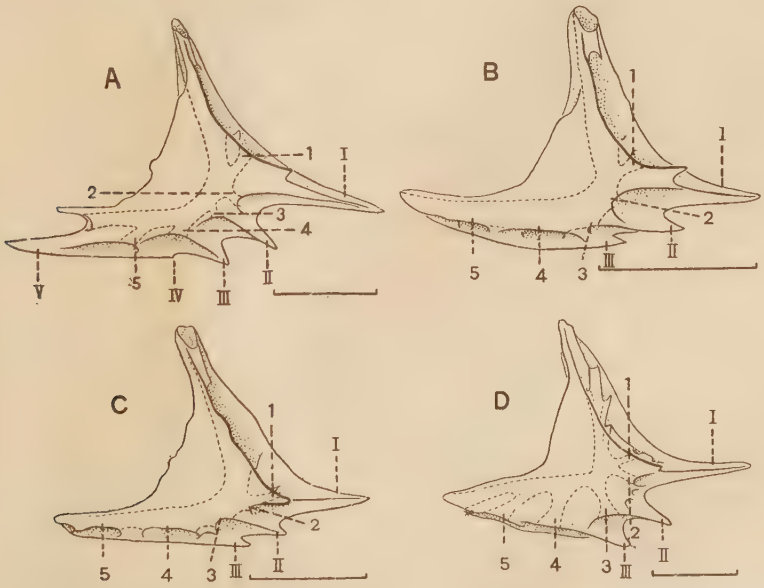

Fig. 18. The outline of the left side of the preoperculum in 4 species of the flatheads, especially showing the configuration of the preopercular spines and the general form of the sensory canal. I to V, preopercular spines; 1 to 5, branches of the preopercular sensory canal. A, *Rogadius asper*; B, *Onigocia spinosa*; C, *O. macrolepis*; D, *Suggrundus meerdervoorti*. The scales each indicates 5mm. Drawn by authors.

the adult of *Platycephalus indicus*, the spines are long and stout, subequal in length or the lower one even longer than the upper (Figs. 17, J and 19, J).

A sharp accessory spine, which is preceded by a sharp keel, is present at the base of the uppermost preopercular spine in all the species except for *Platycephalus indicus*. But the spine is frequently absent in *Inegocia japonica*.

The preopercular sensory canal (Figs. 18–20) is well developed, running through the axis of the bone and opens at both extremities of the bone. It gives off 5 branches toward the outer margin of the bone. The figures of the canal may be

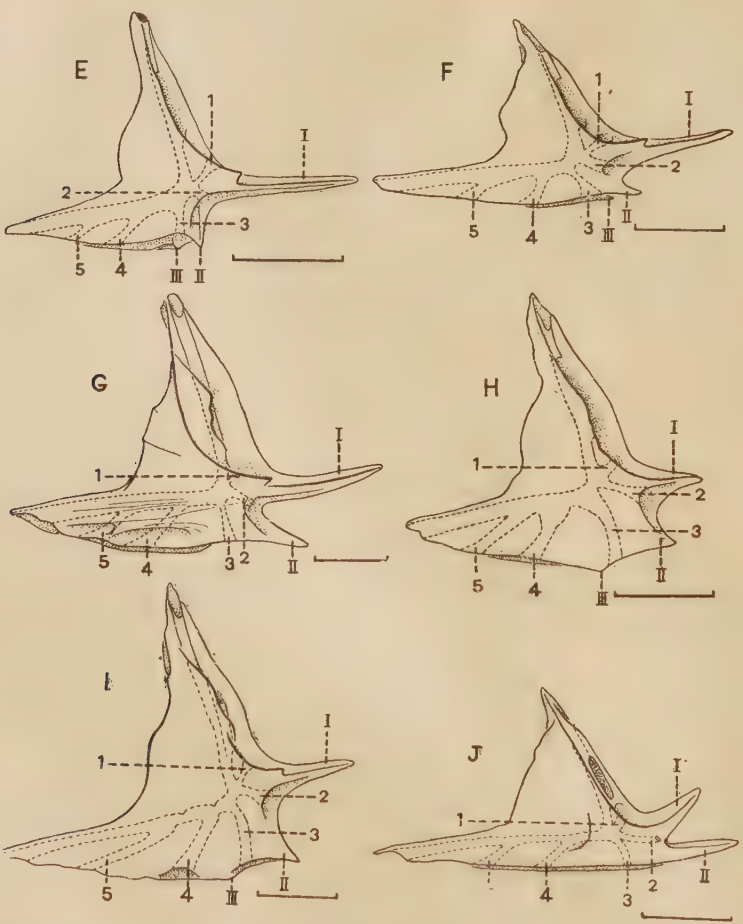

Fig. 19. The outline of the left side of the preoperculum in 6 forms of the flatheads, especially showing the configuration of the preopercular spines and general form of sensory canal. Abbreviated letters are same as in Fig. 2. E, *Kumococius detrusus*; F, *Ratabulus megacephalus*; G, *Cociella crocodila*; H, *Inegocia japonica*; I, *I. guttata*; J, *Platycephalus indicus*. The scales each indicates 5mm. Drawn by authors.

sharply defined into 3 types in 10 species treated here. The first type is represented by *Onigocia spinosa* and *O. macrolepis* (Fig. 20, A). The canal is very thick, widely opens between the first branch and the insertion of the canal, and the branches of the canal are scarcely developed except for moderately developed first branch. The second type involves *Rogadius asper*, *Kumococius detrusus*, *Ratabulus megacephalus*, *Inegocia japonica* and *Platycephalus indicus* (Fig. 20, B). The canal is slender or moderately thick, widely opens between the first branch and the insertion of the canal, and the branches of the canal are short in *Rogadius asper* and very long in the others. The third type is exemplified by *Cociella crocodila*, *Suggrundus meerdervoorti* and *Inegocia guttata* (Fig. 20, C-D-E). The canal is slender as is the case with the second type, but not opens between the first branch and the insertion of the canal. The insertion of the canal is, however, simple in *Cociella crocodila*, separated into 2 parts in *Inegocia guttata*, and ramified into 4 canals in *Suggrundus meerdervoorti*.

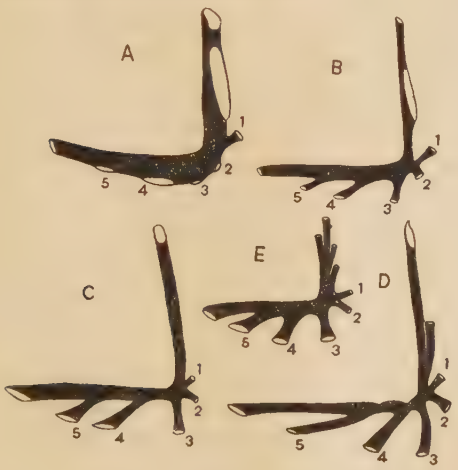

Fig. 20. 3 types of the preopercular sensory canal in flatheads. A, *Onigocia spinosa*; B, *Kumococius detrusus*; C, *Cociella crocodila*; D, *Inegocia guttata*; E, *Suggrundus meerdervoorti*. A, first type; B, second type; C-E, third type. 1 to 5, branches of preopercular sensory canal. Drawn by authors.

Opercle is always armed with 2 pungent spines (Fig. 17, OP). Each spine is preceded by a stout keel except for *Platycephalus indicus*, in which the lower spine is not strengthened by such a keel.

Remarks:— As stated above, the suspensorium and opercular apparatus show so marked differences both qualitatively and quantitatively in 10 species treated here that we can utilize these differences as generic distinctions and apparently offer excellent characteristics of phyletic significance. *Rogadius asper* is peculiar in having 5 preopercular spines including an antrose spine, and in having moderately thick preopercular sensory canal. *Onigocia spinosa* is in common with *O. macrolepis* in every character and they are distinguishable from the others in having 3 distinct preopercular spines, and thick and scarcely branched preopercular sensory canal. *Suggrundus meerdervoorti* allied to 2 species of *Onigocia* in osteological characters, but differs from them in details of the preopercular sensory canal; thus, the organ is slender, the branches are long, the insertion of this organ ramified into 4 distinct tubes, and lacking the opening between ramified insertion and the uppermost branch of the canal. *Kumococius detrusus* closely

resembles *Inegocia japonica*, and differs from the latter only in having much longer uppermost preopercular spine. *Cociella crocodila* and *Inegocia guttata* are also apparently closely related with each other, but in the former the uppermost preopercular spine is much longer, mesopterygoid bone is more or less larger, and the insertion of the preopercular sensory canal is simple. It should be mentioned that in *Ratabulus megacephalus* the interosseous space between metapterygoid lamina and hyomandibular process is entirely covered with the posterior extension of the metapterygoid bone, as is the case with *Platycephalus indicus*. The species, *Ratabulus megacephalus*, however, is apparently more closely related to either *Kumococius detrusus* or *Inegocia japonica* rather than *Platycephalus indicus* in other features of these organs.

Platycephalus indicus is apparently more highly differentiated than other members of this group at least in having the characteristics as: 1) hyomandibular process and metapterygoid lamina are inconspicuous and an interosseous space between them is entirely covered with the posterior extension of the metapterygoid bone, 2) upper half of the metapterygoid bone turned outward, 3) accessory spine at the base of uppermost preopercular spine is entirely absent, 4) lower opercular spine is not strengthened by the ridge or keel, and 5) preopercular spines are always 2 in number and they are always very stout and subequal in length or the lower one is even longer than the upper.

It is interesting to note that the preopercular sensory canal always gives off five branches toward the outer margin of the bone in this group. This fact alone indicates that the ancestor of this group with 5 preopercular spines, although the degeneration of the spines confronts development of the branches. The present explanation is strongly supported by the following facts: According to NAKAMURA (1935, pp. 162–163, figs. 62–65) the youngs of *Platycephalus indicus* smaller than at least about 12.0 mm. in entire length are always provided with 5 preopercular

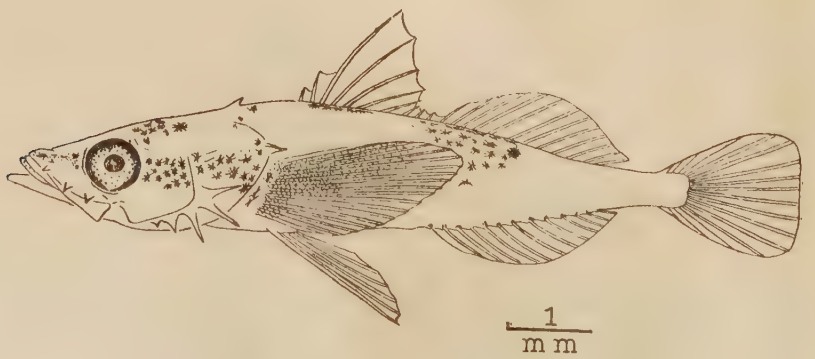

Fig. 21. Young of *Platycephalus indicus* measuring 9.6 mm. in total length. After NAKAMURA, 1935.

spines and directed backward and downward, as is the case with the generalized scorpaenoid fishes (Fig. 21). We are, therefore, justified in assuming that the preopercular spines of the flatheads in the present pattern of modification are the remnants of once much larger structure, which have gradually deteriorated accompanied by the depression of the body form.

9. Hyoid apparatus

In the hyoid apparatus the glossohyal and urohyal are of importance to the taxonomy of this group and offer some probable phyletic relationship between genera.

The glossohyal, the anteriormost ossification of the apparatus supporting the tongue muscle, is connected with the upper element of the basihyal through the check ligament which is inserted from the condyle on the posterior extremity of the glossohyal on each side. The bone varies more or less in shape according to the species. It is generally quadrangular, about as broad as long, in *Onigocia spinosa*, *O. macrolepis*, *Inegocia japonica*, *Cociella crocodila*, *Inegocia guttata*, and *Suggrundus meerdervoorti* (Fig. 22, A•B•D•E•F•G). In *Onigocia* the lateral sides are deeply concave and the rear margin is truncated, whereas in the others both the lateral and posterior margins are moderately or deeply concave.

The bone is usually rectangular in shape, much longer than wide, in *Rogadius asper* and *Ratabulus megacephalus* (Fig. 22, C•H). In the former species the posterior margin is truncated, the lateral sides are shallowly concave, and the bone is not especially widened anteriorly. While in the latter both the posterior and lateral margins are deeply concave, and the bone becomes wider anteriorly in more or less fan-like fashion.

The bone becomes strongly wider anteriorly in fan-like fashion in *Kumococius detrusus* and *Platycephalus indicus* (Fig. 22, I•J), narrowest at the posterior one-fourth or one-fifth of the bone and widest at the anterior extremity. The rear extremity of the bone is deeply concave in *Kumococius detrusus*, but is roundly convex and forms 3 distinct condyles in the other.

The urohyal is also a flattish unpaired bone, placed upright below the basibranchials and the anterior end of the bone is securely fastened to the lower surface of the first basibranchial at the rear end. The anterior margin of this bone is shallowly concave, forming a condyle on each side. A long check ligament is inserted from each condyle, firmly holding the ventral surface of the lower element of the basihyal bone. The urohyal is never directly attached to the glossohyal. It becomes gradually narrower posteriorly and the rear margin is shallowly concave in 2 species of *Onigocia* (Fig. 22, A•B), whereas it is widest at about the posterior one-third (at about middle of the bone in *Inegocia guttata*) of the bone and the posterior margin is deeply concave, forming a pair of prominent lobes in *Inegocia*

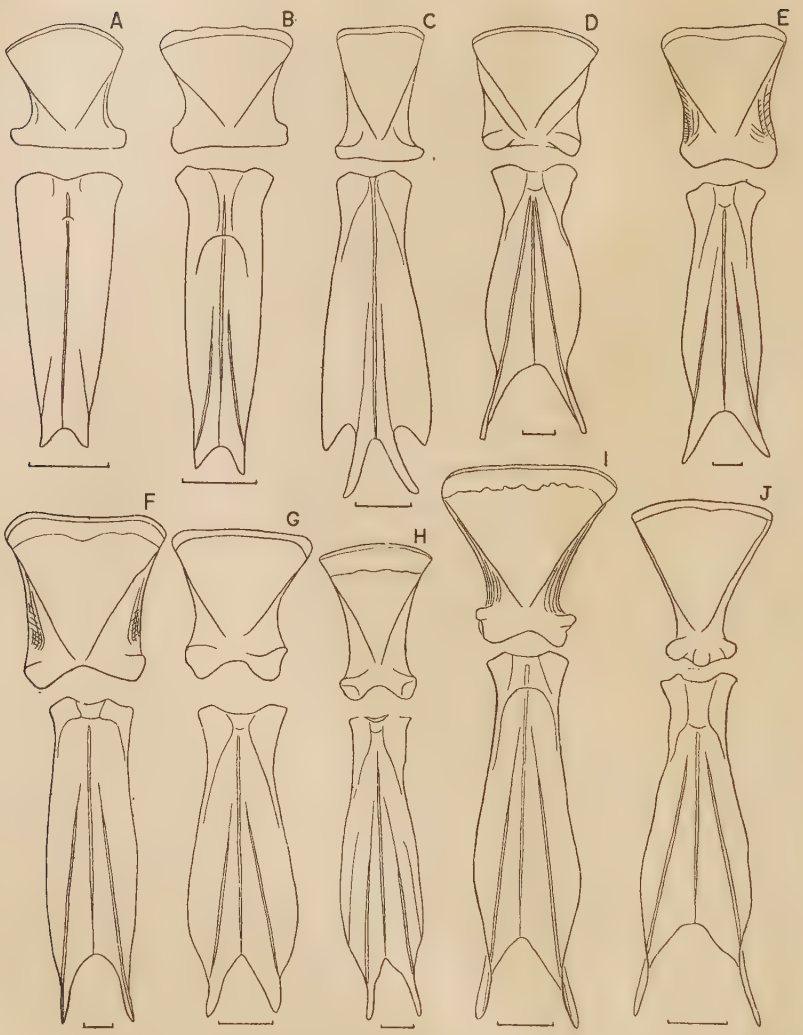

Fig. 22. Lower aspect of the glossohyal and urohyal bones in 10 species of Platycephalidae. A, *Onigocia spinosa*; B, *O. macrolepis*; C, *Rogadius asper*; D, *Inegocia japonica*; E, *Cociella crocodila*; F, *Inegocia guttata*; G, *Suggrundus meerdervoorti*; H, *Ratabulus megacephalus*; I, *Kumococius detrusus*; J, *Platycephalus indicus*. The scales each indicates 2.5mm. Drawn by authors.

japonica, *Cociella crocodila*, *Inegocia guttata*, *Suggrundus meerdervoorti*, *Ratabulus megacephalus*, *Kumococius detrusus* and *Platycephalus indicus* (Fig. 22, D – J). In *Rogadius* the posterior margin is deeply concave as in the precedent, but it is peculiar in that the bone becomes gradually wider posteriorly and that each lobe is deeply incised at the outer basal part of it (Fig. 22, C).

The urohyal is strengthened by a median stout keel and 1 or 2 (only in *Ratabulus*) pairs of weaker lateral keels, and wings of the bone are inclined upward toward the median keel. In *Onigocia* (Fig. 23, A), in which the urohyal is deeply invested in the muscle of the isthmus, the wings are strongly inclined (at a degree of about 45 against the horizontal plane); the lower aspect of the bone is, therefore, deeply concave. In *Inegocia*, *Cociella*, *Suggrundus*, *Ratabulus*, *Kumococius* and *Platycephalus* (Fig. 23, C), in which the bone is shallowly invested in the muscle of the isthmus, the bone is flattish, merely slightly concave between lateral keels; the lower aspect of the bone is nearly flattish. In *Rogadius* (Fig. 23, B) the inclination of wings is just intermediate between the 2 groups aforementioned.

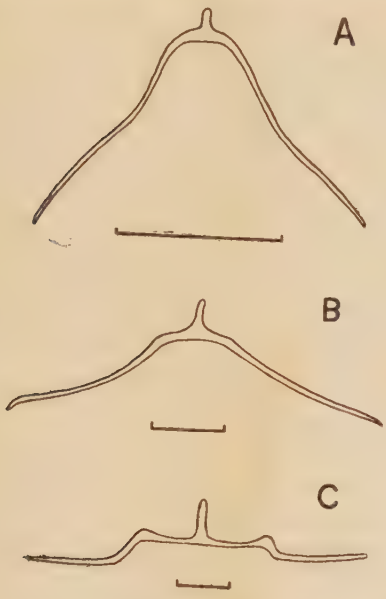

Fig. 23. Cross-section at the middle part of the urohyal bone in 3 species of the platycephalids, especially showing the degree of the inclination of wings of the bone. A, *Onigocia macrolepis*; B, *Rogadius asper*; C, *Inegocia japonica*. The scales each indicates 1mm. Drawn by authors.

Remarks:—Summarizing above *Onigocia* (Fig. 22, A·B; Fig. 23, A) is characterized by 1) grossohyal is quadrangular and the rear margin is truncatd, 2) urohyal becomes gradually narrower posteriorly and the posterior margin is shallowly concave, and 3) urohyal is deeply invested in the muscle of the isthmus, and the lower aspect of the bone is deeply concave.

Rogadius (Fig. 22, C; Fig. 23, B) is characterized by 1) glossohyal is rectangular in shape, not especially becomes wider anteriorly and the posterior margin is truncated, 2) urohyal becomes gradually wider posteriorly and the rear margin is deeply concave, 3) lower aspect of the urohyal is moderately concave, and 4) each posterior lobe of the urohyal is deeply incised at the outer basal part of it.

In *Inegocia*, *Cociella* and *Suggrundus* (Fig. 22, D·E·F·G; Fig. 23, C), 1) glossohyal is quadrangular in shape and the posterior margin is shallowly, moderately or deeply concave, 2) urohyal is widest at about the posterior one-third of the bone (at about middle of the bone in *Inegocia guttata*), and the posterior margin is deeply concave, and 3) urohyal is shallowly invested in the muscle of the isthmus, and the lower aspect of the bone is very shallowly concave between the lateral keels.

Ratabulus (Fig. 22, H) closely resembles the precedent in general form of the

urohyal and *Rogadius* in the form of the glossohyal, but it is characterized by 1) glossohyal, which is rectangular in shape, is deeply concave along both lateral and posterior margins, and the bone becomes wider anteriorly in more or less fan-like fashion, and 2) urohyal is strengthened by 2 pairs of lateral keels in addition to a median stout keel.

Kumococius (Fig. 22, I) is closely allied to *Inegocia*, *Cociella* and *Suggrundus*, but is sharply distinguished from them in having broad fan-like glossohyal.

Platycephalus is nearest to *Kumococius* at least in having the fan-like glossohyal, but is distinguished from it in having narrower glossohyal, and its posterior margin is roundly convex, forming 3 distinct condyles.

It is interesting to note that the glossohyal and urohyal of this group are much wider and larger than those of the scorpaenoid fish (MATSUBARA, 1943, pp. 45–49, figs. 16–20). The development of these elements in flatheads appears to have been deeply subjected to the modification of the bodily structure of this group, in which the body is greatly depressed and much lower than that of the scorpaenoid fishes.

10. Cranium

The bony elements constituting the cranium and their general arrangement are exactly the same in all the Japanese flatheads and typical in those of the scorpaenoid fishes (MATSUBARA, 1943, pp. 55–85, figs. 21–39), but the general form of the cranium and the configuration of certain elements of this organ sometimes present remarkable differences in the present 10 species. In order to make out these differences satisfactorily in these species, we made the comparative study of this organ in both quantitatively and qualitatively. In the former case the measurements of various parts of the cranium are standarized as indicated below by using the mm. graph-sheet as KURONUMA did in his study on the Japanese globe-fishes (KURONUMA, 1943, p. 120) :

1. The standard length of the cranium is the length between tip of the vomer and rear end of the basioccipital bone.

2. The depth of the cranium is measured at the vertical line through the middle part of the supraoccipital crest.

3. The width of the cranium is measured in the widest part at pterotics.

4. The interorbital space is the least width of the interorbital region.

5. The width of the preorbital region is referred to the length between 2 antero-lateral ends of the ectethmoid.

6. The width of the mesethmoid is the least width of the bone measured at the nasal region.

7. The rostral length of the cranium is measured from tip of the vomer to the line between antero-lateral ends of the ectethmoid.

8. The diameter of the orbit is indicated by the distance between the postero-lateral end of the ectethmoid and the antero-lateral end of the sphenotic bone.

9. The postorbital length of the cranium is represented by the length between the antero-lateral end of the sphenotic bone and the rear end of the basioccipital bone.

General form of the cranium :—The general form of the cranium varies rather extensively according to the species, although it is always greatly depressed. The depth in standard length of the cranium is about 5.0 times in *Onigocia macrolepis*, *O. spinosa*, *Rogadius asper*, *Kumococius detrusus* and *Suggrundus meerdervoorti* (Fig. 24, A–E), about 6.0 times in *Inegocia japonica* and *Cociella crocodila* (Fig. 25, F-G), about 6.5 times in *Inegocia guttata* and *Ratabulus megacephalus* (Fig. 25, H-I), and 7.0 times in *Platycephalus indicus* (Fig. 25, J). The width is distinctly greater than the postorbital length of the cranium in *Onigocia*, *Rogadius*, *Kumococius* and *Suggrundus*, distinctly narrower than the latter in *Inegocia*, *Cociella* and *Ratabulus*, and much narrower, about 1.4 times in the latter, in *Platycephalus*.

The interorbital region is deeply concave except for *Cociella* and *Platycephalus*, where it is shallowly concave; the width in standard length of the cranium is about 14.0 times in *Rogadius*, about 11.0 times in *Ratabulus*, 9.0 to 10.0 times in *Onigocia*, *Kumococius*, *Suggrundus* and *Inegocia*, about 8.0 times in *Cociella*, and about 6.0 times in *Platycephalus*. No remarkable differences are found to exist in the relative width of the preorbital region; in standard length of the cranium the width is about 3.0 to 3.5 times in *Onigocia*, *Rogadius*, *Kumococius*, *Suggrundus*, *Cociella* and *Platycephalus*, and about 4.0 times in *Inegocia* and *Ratabulus*.

The general form of the rostral region of the cranium differs rather remarkably; the width of the mesethmoid in the rostral length of the cranium is 2.0 times in *Onigocia*, *Suggrundus* and *Platycephalus*, about 3.5 to 4.0 times in *Rogadius*, *Kumococius* and *Cociella*, about 4.5 times in *Inegocia*, and about 5.5 times in *Ratabulus*.

The orbit is much smaller in *Platycephalus* than in the others, the diameter being about 5.5 times in the standard length of the cranium instead of being about 3.0 times in *Onigocia*, *Rogadius*, *Kumococius*, *Suggrundus* and *Inegocia* (*japonica*), and about 4.0 times in *Cociella*, *Inegocia* (*guttata*) and *Ratabulus*. The post-orbital part of the cranium is 3 times as long as the diameter of the orbit in *Platycephalus*, whilst it is always shorter than twice the diameter of the latter in the others.

Configuration :—The anterior half of the vomer is usually quadragular in shape, and bears a well-developed median longitudinal keel, so-called the mesethmoid-vomerine keel, on the upper surface. In *Platycephalus*, however, the bone is strongly dilated outward at the anterior extremity, and the mesethmoid-vomerine keel is feebly developed (Fig. 25, J). The lower surface of the bone is usually narrow and

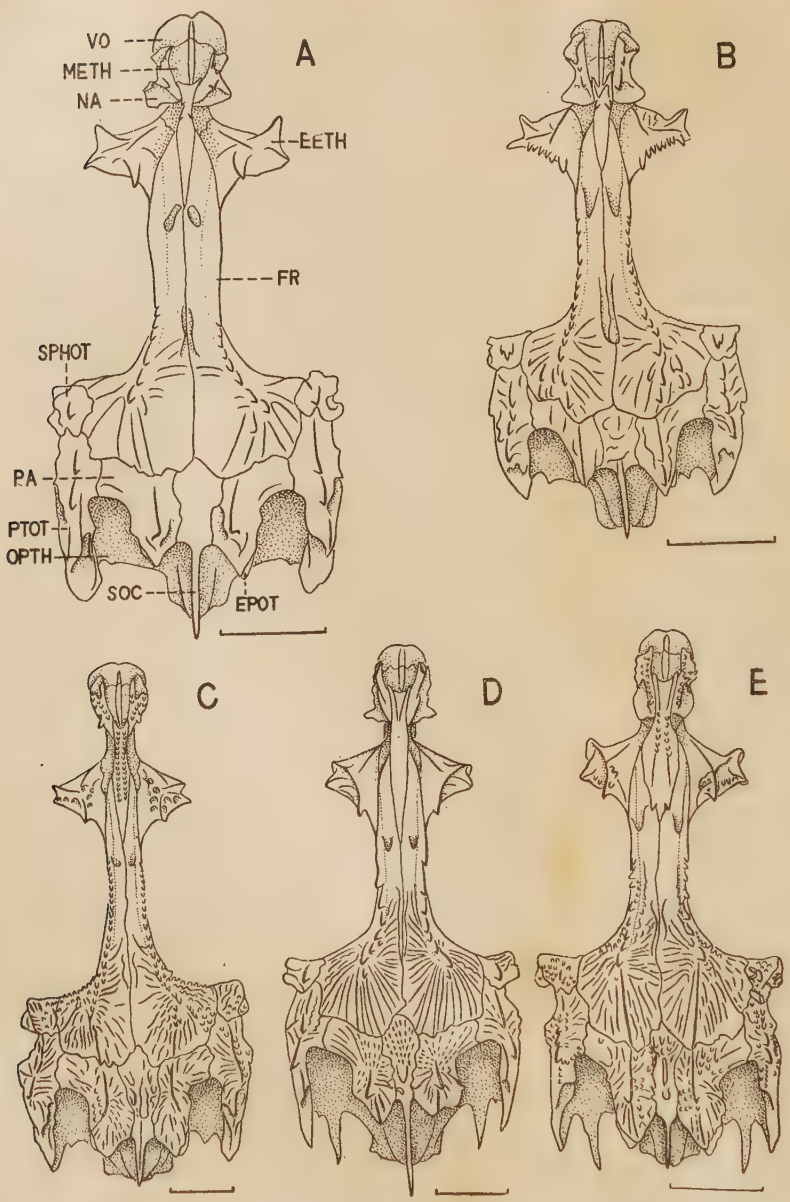

Fig. 24. The upper aspect of the cranium in 5 species of the flatheads, especially showing the general form of the cranium and the configuration of the elements. EETH, ectethmoid; EPOT, epiotic; FR, frontal; METH, mesethmoid; NA, nasal; OPTH, opisthotic bone; PA, parietal; PTOT, pterotic; SOC, supraoccipital; SPHOT, sphenotic; VO, vomer. A, *Onigocia macrolepis*; B, *O. spinosa*; C, *Rogadius asper*; D, *Kumococius detrusus*; E, *Suggrundus meerdervoorti*. The scales each indicates 5mm. Drawn by authors.

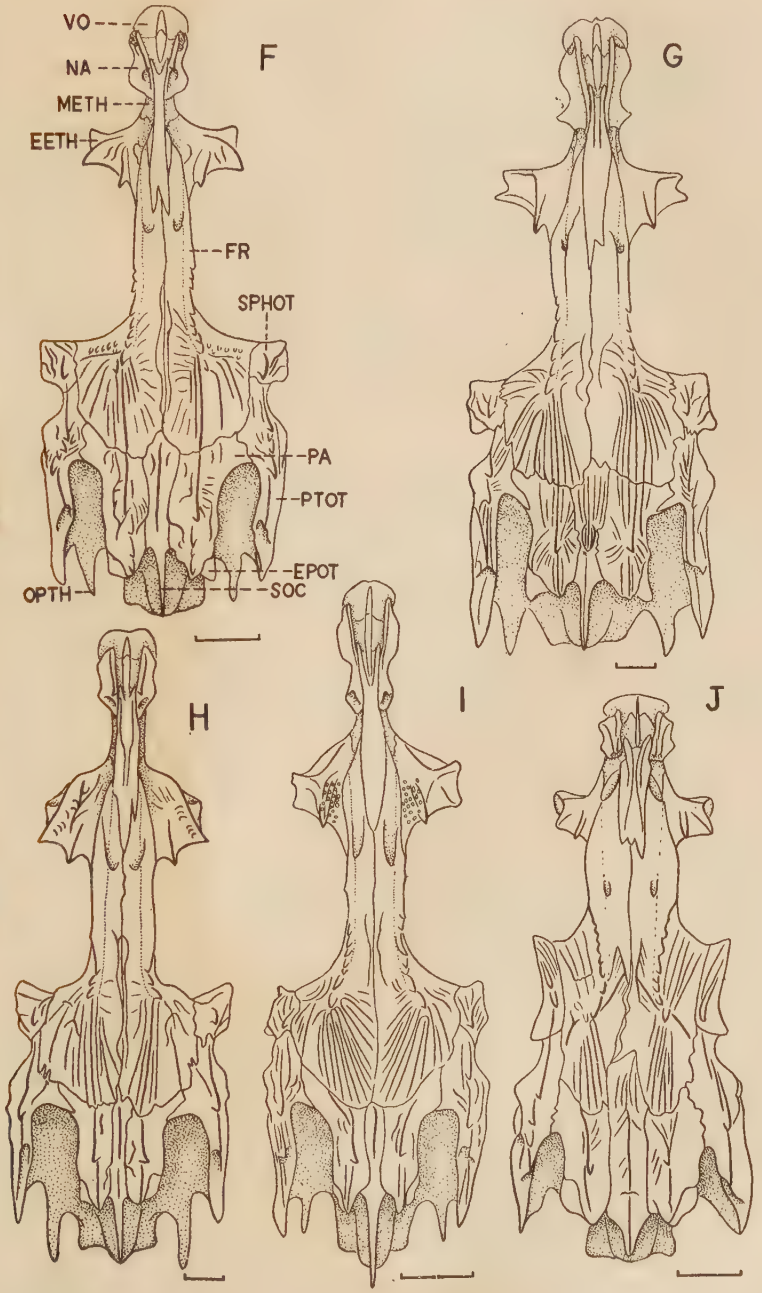

Fig. 25. The upper aspect of the cranium in 5 species of the flatheads, especially showing the general form of the cranium and the configuration of the element. Abbreviations are the same as in Fig. 24. F, *Inegocia japonica*; G, *Cociella crocodila*; H, *Inegocia guttata*; I, *Ratabulus megacephalus*; J, *Platycephalus indicus*. Drawn by authors.

roundish, but very wide and flattish in *Platycephalus*.

The mesethmoid is armed with 2 parallel rows of granular spines on the upper surface in *Rogadius* and *Suggrundus* (Fig. 24, C-E), but is entirely smooth in the others. A pair of mesethmoid processes is well developed, each bears a nasal bone which is tunneled. The nasal bone is armed with several more or less sharp spines in *Onigocia*, many small granular ones in *Rogadius* and *Suggrundus*, and very frequently a single spine in *Inegocia* and *Platycephalus*, but is entirely smooth in the others.

The ectethmoid is armed posteriorly with a preocular spine, which is usually pungent, but very indistinct in *Platycephalus* (Fig. 25, J). In addition to this spine the posterior part of the bone is armed with a row of several smaller but pungent ones in *Onigocia* (*spinosa*) and scattered with several granular ones in *Suggrundus* (Fig. 24, B-E).

The frontal bone is the largest paired bone placed on top of the cranium, forming the interorbital region anteriorly and a part of the postorbital region of the cranium posteriorly. The interorbital region is usually slender and much longer than the postorbital region of this bone, while in *Platycephalus* the former is robust and stout, and slightly shorter than the latter. The supraorbital rim of this bone is moderately or highly elevated and armed with a series of spines, forming a supraorbital spinous ridge. The spines extend throughout the entire supraorbital rim in *Onigocia* (*spinosa*) and *Rogadius* (Fig. 24, B-C), confined to the posterior half of it in *Onigocia* (*macrolepis*), *Kumococius*, *Suggrundus*, *Inegocia* (*japonica*), *Cociella* and *Ratabulus* (Fig. 24, A-D-E; Fig. 25, F-G-I), and the posterior one-third of it in *Inegocia* (*guttata*) (Fig. 25, H). While in *Platycephalus* the supraorbital rim is little elevated, smooth, and the supraorbital spinous ridge is deprived of its normal position, beginning from the rear end of the supraorbital margin and extends to the central part of the postorbital region of this bone. The anterior margin of the postorbital region of the frontal bone, which forms the posterior rim of the orbit, is usually opposite the anterior margin of the prootic bone or the vicinity. In *Platycephalus*, however, the region extends forward together with the sphenotic far beyond a vertical through the anterior margin of the prootic. The result of this mechanical consequence is that the supraorbital spinous ridge is deprived of its normal position and the orbit becomes much smaller than in the other members of this group. Fine ridges are radiating on the frontal bone from the last supraorbital spine. The ridges in front of the spine are, however, usually inconspicuous except for *Platycephalus*, in which they are well developed both before and behind the spine. The ridges are fewer in *Onigocia* (*macrolepis*) than in the others; they are generally smooth, but is roughened by granulations in *Rogadius*, *Kumococius* and *Suggrundus*.

The parietals are always widely separated, each being strengthened by a stout

longitudinal ridge, which is usually armed with a spine except for *Rogadius*. The spine is usually strong and pungent, but very inconspicuous in *Platycephalus*. In addition to this spine 2 or 3 smaller ones are set in a series behind it in *Inegocia* (*japonica*). The upper surface of the bone is sculptured by many fine smooth ridges in *Cociella*, roughened by many granular ridges in *Rogadius*, *Kumococius* and *Suggrundus*, but relatively smooth in the others.

The sphenotic bone is usually quadrangular or hexagonal in upper aspect and about as long as wide or slightly longer than wide. While in *Platycephalus* the bone is very long, slightly more than 3 times as long as wide. The bone is usually armed with a sharp spine except for *Rogadius*. In *Rogadius* and *Suggrundus* the surface of the bone is roughened by granules.

The pterotic bone, the postero-lateral ossification on the upper surface of the cranium, is armed with 1 to 4 spines. The upper surface is roughened by many granular ridges in *Rogadius*, *Kumococius* and *Suggrundus*.

The opisthotic bone, a scale-like ossification on each side of the posterior part of the cranium, is rectangular in shape, bearing usually a horny process posteriorly except for *Platycephalus*. The process is rudimentary in *Onigocia* and *Rogadius*, but is conspicuously well developed in the others.

The basisphenoid is constantly present and producing a process downward and forward from the middle part of the bone; the process is rather stout and entirely meets the upper median longitudinal keel of the parasphenoid in *Rogadius*, *Kumococius*, *Suggrundus*, *Inegocia* and *Cociella*; but the process is long and slender in *Platycephalus*, very short and rather stout in *Onigocia* and *Ratabulus*, and free from the parasphenoid in all.

The parasphenoid, the splint-like ossification forming the base of the cranium, is flattish and wide in *Platycephalus*, very narrow and roundish in *Onigocia* and *Rogadius*, and intermediate between these 2 groups in the others. The upper median longitudinal keel of the parasphenoid is well developed, the anterior part of the keel is meeting the junction of the frontals with an intervention of a patch of the cartilage, leaving a window in front of the basisphenoid; the window, however, is much smaller in *Platycephalus* than in the others.

Remarks:—Summarizing the important osteological characteristics of the cranium we consider, in the Japanese flatheads, it seems very reasonable to classify the organ into 2 major types, *Platycephalus* on one hand and the rest on the other. In the latter group, however, the manner of specialization is so complex that it may further be subdivided into 5 minor types.

Platycephalus, which is obviously more highly specialized than the others, is peculiar in having such characteristics as: 1) the upper surface of the cranium is well sculptured by fine ridges, but bears neither strong spines nor granules, 2) the postorbital region of the cranium is very long, about 1.4 times as long as wide and

about 3 times as long the diameter of the orbit, 3) the vomer is strongly dilated outward at the anterior end, and so-called mesethmoid-vomerine keel is feebly developed, 4) the lower surfaces of both vomer and parasphenoid are very wide and flattish, 5) the supraorbital rim of the frontal bone is little elevated, smooth, and the supraorbital spinous ridge is deprived of its normal position and located behind the interorbital region, 6) the anterior part of the postorbital region of the frontal bone extends anteriorly together with the sphenotic bone far beyond a vertical through the anterior margin of the prootic, 7) the sphenotic is very long, slightly more than 3 times as long as wide, 8) the window between orbits lying in front of the basisphenoid is very small, 9) the opisthotic bone is bearing no horny process posteriorly, and 10) the ventral process of the basisphenoid is long and slender, but free from the parasphenoid.

The other type represented by 9 species quite differs from the precedent in the following points: 1) the ridges on upper surface of the cranium is either roughly granulated or armed with strong spines, 2) the postorbital region of the cranium is always shorter than twice the diameter of the orbit, 3) the vomer is not dilated outward at the anterior end, and the mesethmoid-vomerine keel is strongly developed, 4) the lower surfaces of the vomer and parasphenoid are narrow and roundish, 5) the supraorbital rim of the frontal bone is elevated and armed with a series of the spinous ridge, 6) the anterior part of the postorbital region of the frontal bone, which forms the posterior rim of the orbit, is opposite the anterior margin of the prootic or the vicinity, 7) the sphenotic is not elongate, about as long as wide or slightly longer than wide, 8) the window between orbits lying in front of the basisphenoid is moderately or very large, 9) the opisthotic bone bears a horny process posteriorly. This type is splitted into 5 minor types by the armature of the upper surface of the cranium, the relative length of the postorbital part of the cranium, the degree of the development of both horny process from the opisthotic bone and ventral process of the basisphenoid. *Onigocia spinosa* is in common with *O. macrolepis* in these features although the latter is less armed. In this subgroup, which is presumably most primitive, the top of the cranium is scarcely granulated and armed with rather sharp spines, the cranium is much wider than the postorbital length of the organ, the opisthotic bone bears a rudimentary horny process posteriorly, and the ventral process of the basisphenoid is very short and entirely free from the parasphenoid. *Rogadius*, which represents the second subgroup, closely resembles the precedent in having a wide cranium and a rudimentary horny process posteriorly from the opisthotic bone, but is distinguished from it in having a well-developed ventral process of the basisphenoid which is entirely meeting the parasphenoid, and finely and thickly granulated cranium. In the third subgroup, which is represented by *Kumococius* and *Suggrundus*, the cranium is wide and well granulated and the ventral process of the basisphenoid is well developed, as is the case with the precedent, but the horny

process from the opisthotic bone is well developed, extending posteriorly far beyond the rear end of the parietal bone. The fourth subgroup represented by *Inegocia* and *Cociella* allied to the third one in having a well-developed ventral process of the basisphenoid and long horny process posteriorly from the opisthotic bone, but is exclusive from it in having the narrower cranium which is distinctly narrower than the postorbital length of the cranium, and the smooth cranium which is sculptured by fine ridges armed with no granules. *Ratabulus* representing the fifth subgroup is distinguished from the precedent mainly in having rudimentary ventral process of the basisphenoid which is never in contact with the parasphenoid.

11. Shoulder girdle

The bony elements constituting this organ and their general arrangement are recognizable essentially to be same in 10 species treated here and typical in those of the scorpaenoid fishes (MATSUBARA, 1943, pp. 105–119, figs. 40–43), but the general form of the supraclavicle, clavicle and the relative size of the actinosts may presumably offer some probable phyletic relationship between genera.

Configuration :—Roughly speaking, the supraclavicle (SRCL in Fig. 26) is either rectangular or rhombic in shape. It is about 1.6 to 1.7 times as long as wide in

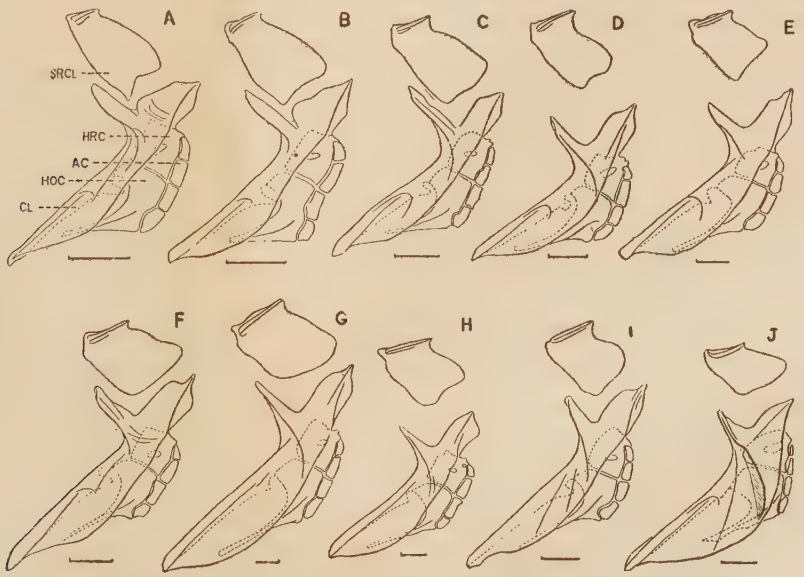

Fig. 26. The lower part of the shoulder girdle in 10 species of the Japanese flatheads. AC, actinost; CL, clavicle; HOC, hypocoracoid; HRC, hypercoracoid; SRCL, supraclavicle. A, *Onigocia macrolepis*; B, *O. spinosa*; C, *Rogadius asper*; D, *Suggrundus meerdervoorti*; E, *Kumococius detrusus*; F, *Inegocia japonica*; G, *Cociella crocodila*; H, *Inegocia guttata*; I, *Ratabulus megacephalus*; J, *Platycephalus indicus*. The scales each indicates 5mm. Drawn by authors.

Onigocia macrolepis, *O. spinosa*, *Rogadius asper* and *Suggrundus meerdervoorti* (Fig. 26, A–D), about 1.2 to 1.3 times as long as wide in *Kumococius detrusus*, *Inegocia japonica*, *Cociella crocodila*, *Inegocia guttata* and *Ratabulus megacephalus* (Fig. 26, E–I), but about as long as wide in *Platycephalus indicus* (Fig. 26, J).

The clavicle is well developed; the upper lamina, which is always much larger than the lower one, varies in size according to the species. It covers anterior one-third of the hyper- and hypocoracoid in *Onigocia* (Fig. 26, A-B), anterior half of them in *Rogadius*, *Suggrundus*, *Kumococius*, *Inegocia*, *Cociella* and *Ratabulus* (Fig. 26, C–I), and nearly their entire surface in *Platycephalus* (Fig. 26, J). The upper lamina is stiffened by a keel which runs backward and downward from the upper anterior process of the bone. The keel is feeble in *Onigocia*, highly elevated in *Platycephalus*, and their intermediate in the others. The lower lamina of this bone is generally feebly developed; it is usually conically produced outward immediately below the quadrangular part of the hypocoracoid, forming a deep notch between the process and the hypocoracoid. The conical process, however, is absent in *Platycephalus*. The upper part of the clavicle is forked into 2 stout process, the outer one is short and triangular in shape in *Platycephalus*, but rather long and teat-like in shape in the others; the inner margin of the outer process is roundly produced basally in *Onigocia*, but never especially produced in the others.

The actinosts are 4 in number, rectangular in shape and much wider than long. They are much smaller in *Platycephalus* than in the others.

Remarks:—Summarizing above *Onigocia* (Fig. 26, A-B) is characterized by 1) the supraclavicle is very large, about 1.7 times as long as wide, 2) the upper lamina of the clavicle is less developed, covering about anterior one-third of the coracoids, and 3) the clavicle is roundly produced basally along the inner margin.

Rogadius, *Suggrundus*, *Kumococius*, *Inegocia*, *Cociella* and *Ratabulus* (Fig. 26, C–I) are much nearer the precedent than *Platycephalus* in general form of this organ, but they are distinguished from the former by characteristics such as: 1) the supraclavicle is smaller except for *Rogadius* and *Suggrundus*, about 1.2 to 1.3 times as long as wide, 2) the upper lamina of the clavicle covers anterior half of the coracoids, and 3) the outer process on anterior part of the clavicle is never produced basally along the inner margin.

Platycephalus (Fig. 26, J), in which the organ is undoubtedly more highly specialized than in the others, is characterized by 1) the supraclavicle is smaller, about as long as wide, 2) the upper lamina of the clavicle covers nearly the entire surface of the coracoids, 3) the upper surface of the clavicle is highly keeled, 4) the lower lamina of the clavicle is never especially produced backward immediately below the quadrangular part of the hypocoracoid, and 5) the actinosts are very small.

12. Pelvic girdle*

So far as our investigations go, the flatheads alone are peculiar, among the mail-cheeked fishes, at least in having a large ovoid interosseous space between opposite halves of the pelvic girdle. As might be expected, moreover, some of the characteristics of this organ are considered to be of much consequence for the generic significance, although the structural differences of this organ have never been applied to the taxonomy of this group.

Configuration :—The girdle is composed of 2 thin, horizontally expanded plates, strongly arched outward and the opposite halves adjoining simply at their distal ends both anteriorly and posteriorly, leaving a large ovoid interosseous space between them. Roughly speaking, therefore, the girdle is, as a whole, circular or equilateral triangular in general form when viewed from the upper or lower side, and becomes gradually narrower anteriorly.

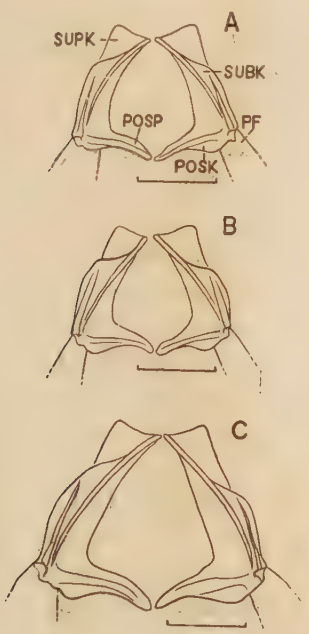

Fig. 27. The lower aspect of the pelvic girdle in 3 species of the Japanese flatheads, especially showing the well-developed suprapelvic keel. PF, pelvic fin; POSK, postpelvic keel; POSP, postpelvic process; SUBK, subpelvic keel; SUPK, suprapelvic keel. A, *Onigocia macrolepis*; B, *O. spinosa*; C, *Rogadius asper*. The scales each indicates 10mm. Drawn by authors.

The subpelvic process and pelvic pore, all of which are found in the scorpaenoid fishes, are entirely absent in this group. The postpelvic process (POSP in Figs. 27–29), which extends directly backward in the scorpaenoid fishes, is turned inward and very slightly backward and meets the fellow of the opposite side (Matsubara, 1943, pp. 120–126, fig. 44). The process is usually simple and bluntly pointed (Figs. 27–28), while it is bicuspid in *Ratabulus megacephalus* and tricuspid in *Platycephalus indicus* (Fig. 29, I-J). The postpelvic keel (POSK in Figs. 27–29), which is produced backward from the axis of the postpelvic process, is simply roundish in outline in most genera, but is produced into a large spinous process only in *Platycephalus* among the flatheads (Fig. 29, J).

The subpelvic keel (SUBK in Figs. 27–29) is expanded outward from the lower side of the axis of the girdle,

* For the terminology of various parts of this organ see Matsubara, 1943, p. 120.

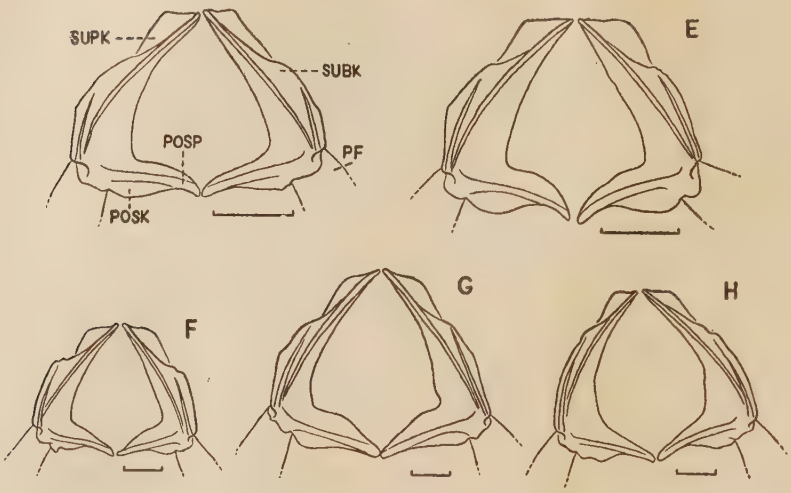

Fig. 28. The lower aspect of the pelvic girdle in 5 species of the Japanese flatheads. Abbreviations are same as in Fig. 27. D, *Kumococius detrusus*; E, *Suggrundus meerdervoorti*; F, *Inegocia japonica*; G, *Cociella crocodila*; H, *Inegocia guttata*. The scales each indicates 10mm. Drawn by authors.

then turned upward; it is usually simply roundish in outline, but is produced forward and slightly inward into a falciform process in *Platycephalus* (Fig. 29, J). The suprapelvic keel (SUPK in Figs. 27–29) is produced upward and outward from the upper side of the axis of the girdle, becomes higher anteriorly and is in contact with the postero-lateral part of the clavicle at the anterior extremity. In *Onigocia macrolepis*, *O. spinosa* and *Rogadius asper* the keel is very high anteriorly, extends beyond the anterior end of the axis of the girdle, forming a right angle at the upper anterior extremity (Fig. 27, A–C). But in the others the keel is moderately high anteriorly, and never extends beyond the anterior end of the axis of the girdle, forming an obtuse angle at the upper anterior extremity.

Remarks:—Summarizing above, we aligned the pelvic girdle of the Japanese flatheads into 4 groups. In 2 genera, *Onigocia* and *Rogadius*, the postpelvic process is simple and bluntly pointed, the postpelvic and subpelvic keels are simply roundish in outline, and the suprapelvic keel is very high anteriorly, extends beyond the anterior end of the axis of the girdle, forming a right angle at the upper anterior extremity (Fig. 27).

The 4 genera, *Kumococius*, *Suggrundus*, *Inegocia* and *Cociella* are closely related to the precedent, but differ from it in having less-developed suprapelvic keel, which never extends beyond the anterior end of the axis of the girdle, forming an obtuse angle at the upper anterior extremity (Fig. 28).

The genus *Ratabulus* is characterized in having the bicuspid postpelvic process, but agrees well with the second group in other features (Fig. 29, I).

Platycephalus, in which the girdle may presumably be more highly specialized than in the others, is peculiar in having such characteristics as: 1) the postpelvic process is tricuspid, 2) the postpelvic keel is produced as a spinous process which is directed inward and backward, and 3) the subpelvic keel is well developed, bearing anteriorly a conspicuous falciform process which is directed forward and slightly inward. The suprapelvic keel in this genus forms an obtuse angle at the upper anterior extremity, as is the case with *Ratabulus* (Fig. 29, J).

13. Alimentary canal and pyloric coeca

The digestive system of the Japanese flatheads has been best studied by Suyehiro (1942, pp. 206–208, figs. 156–157). He observed 2 species, *Platycephalus indicus* and *Inegocia japonica* and found that they are almost the same with each other in this organ.

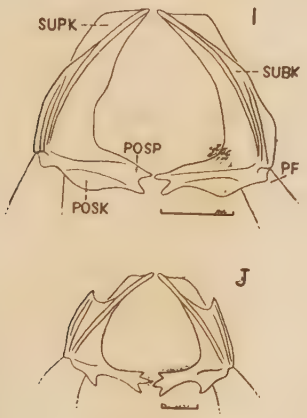

Fig. 29. The lower aspect of the pelvic girdle in 2 species of the Japanese flatheads. Abbreviations are the same as in Fig. 27. I, *Ratabulus megacephalus*; J, *Platycephalus indicus*. The scales each indicates 10mm. Drawn by authors.

The alimentary canal in this group closely resembles that of the scorpaenoid fishes (Matsubara, 1943, pp. 148–158, figs. 59–64). The stomach is Y-shape, with a large blind sac either dilated or rather slender. The intestine, which runs along the right side of the stomach, first descends to near the rear end of the coelomic cavity, then turns forward and ascends to near the level of the basal part of the pyloric appendage where it again bends backward.

The pyloric appendages are inserted in a whorl around the beginning of the duodenum, extending posteriorly along the ventral and right side of the stomach and opening independently at each base. The appendages are usually 5 in number in *Onigocia* and *Ratabulus*, 6 or 7 in *Rogadius*, *Suggrundus*, *Cociella* and *Inegocia*, and commonly 10 in *Platycephalus*, of which 1 or 2 are constantly concealed under the anterior wind of the intestine on right side of the stomach and the others are exposed on ventral side of the same.

Remarks: — As one of the characteristics of *Platycephalus insidiator* (= *P. indicus*), Günther (1860, p. 177) has mentioned "Caec. pylor. 8." In his description of *Platycephalus indicus*, Suyehiro (1942, p. 207) also wrote as "pyloric appendage 6, rarely 7, all long." In fig. 156 b, however, he illustrated 8 distinct

appendages. At any rate, it is very probable that they overlooked 2 appendages which are concealed under the anterior wind of the intestine on right side of the stomach.

V. General consideration

1. Some adaptational significance found in the Platycephalidae and its related forms

As already commented by MATSUBARA (1943, p. 160), the fishes of the families Platycephalidae, Bembridae and Hoplichthyidae are, as a whole, to be closely related to a specialized scorpaenid, *Plectrogenium nanum* GILBERT, characterized by having the head depressed and roughly armed, the eye directed obliquely upward, and the belly flattened. There is no room for doubt, judging from their body form, that they are slow swimmer or walker and spend most of their time on the sea-floor, supporting their body by either the pectoral or the pelvic fins. STARKS (1930, p. 91) stated on the form of the actinosts as "In general the bottom living forms, especially those that use the pectoral fins to brace themselves while at rest, have the actinosts wide, flat, firmly attached, and often quadrangular, as in the cottoid fishes. The free swimming fishes usually have them long and somewhat movable or loosely attached, making a more flexible fin. There are many exceptions to both of these conditions,....." So far as our observations go, the actinosts are rather long in *Plectrogenium* and Hoplichthyidae, whereas they are short and deep in Bembridae and Platycephalidae. Is it not very reasonable to consider, therefore, that the pectoral fins have much to do with swimming or walking in *Plectrogenium* and Hoplichthyidae? This view is well supported by the fact that the base of the pectoral fin is very wide in these 2 groups, and further the lower pectoral rays are produced into a distinct lobe in the *Plectrogenium* and the lower 3 or 4 pectoral rays are detached from the upper rays in the Hoplichthyidae. On the other hand, in the Platycephalidae, in which the actinosts are short and deep, the pelvic girdles are enormously well developed, which is not the case with the Bembridae and the Hoplichthyidae, leaving a large ovoid interosseous space between opposite halves of the girdle. Judging from this structural evidence, the platycephalids appear to be very slow swimmers or almost motionless, and brace themselves while at rest on the sea-floor by the well-developed pelvic fins. It is interesting to note that in the Bembridae the actinosts are short and deep as in the Platycephalidae, but the pelvic girdle is small and opposite halves of the organ are fully connected as in the *Plectrogenium*. This fact may suggest that the Bembridae represents a transitional group between the *Plectrogenium* and the Platycephalidae, so far as the locomotion is concerned.

2. Position of the Platycephalidae among Loricati

Despite a bulk of the literature dealing with the taxonomy of the Platycephalidae, little is known regarding the phyletic relationship of this group. By examining the excellent figures of the skull of *Platycephalus marmoratus* by KESTEVEN in 1926, GREGORY (1933, p. 330) pointed out as: "……, which seems to be a relatively primitive species, not very far from the central scorpaenoid type." In his study on the Japanese scorpaenoid fishes MATSUBARA (1943, p. 160) made the following suggestion: "Platycephalids appear to be relatively primitive……, but there is no room for doubt that they are more highly specialized than the generalized scorpaenids at least in having the compact suborbital stay, reduced number of preopercular spines and more or less flattened cranium." In the present state of our knowledge it is impossible to produce conclusive evidence to contest against these views. In the same study, however, MATSUBARA (1943, p. 160) stated as: "The fishes belonging to the families Bembridae and Hoplichthyidae are apparently highly specialized offshoots sprung off from the Platycephalidae at least in having a much flattened head, more roughly armed suborbital stay and more anterior insertion of the ventral. It is worthy of a special mention that a scorpaenid, *Plectrogenium nanum*, is closely related to the Bembrids at least in having the following peculialities: 1) the head is more or less depressed, 2) the eye is obliquely directed upward, 3) a series of prominent spines are present on sides of head, 4) the preopercular spines are rudimentary except for a well developed uppermost one, and 5) the body is covered with large ctenoid scales." Although in the Bembridae the head is apparently more roughly armed and pelvic fins are more advanced in position than in the Platycephalidae, yet we can see no valid reasons at this time for his phyletic sequence that the Bembridae is highly specialized offshoot sprung off from the Platycephalidae.

Bembrids are in common not only with the platycephalids and the hoplichthyids but also with a specialized scorpaenid, *Plectrogenium* in 1) the head and body are more or less depressed, 2) the head is roughly armed with spinous ridges, 3) the eye is directed obliquely upward, 4) the preopercular margin is armed with 1 to 5 spines, 5) suborbital bones are formed by a preorbital and 4 suborbital bones, the second suborbital bone is forming a compact suborbital stay, and 5) vertebrae are constantly 27 inclusive of the urostyle. But, as shown in Table 3, the genus *Bembras* is apparently more generalized than platycephalids at least in having less depressed head, 3 well-developed preopercular spines, and fully connected pelvic girdles as in scorpaenids instead of bearing a large ovoid interosseous space between opposite halves of the girdle. Especially, the genus *Parabembras* is further generalized at least in having 3 strong anal spines and 5 anal soft rays as in some scorpaenids. This view is strongly supported by the fact that youngs of *Platycephalus*

indicus have the ventrals inserted immediately below origin of the pectorals — at least as indicated by NAKAMURA (1935, pp. 162–163, figs. 62–65) (See Fig. 21). The hinder position of the insertion of the pelvic fin in adult of the platycephalids than that of the bembrids is merely due, in our observation, to the enormous development of the pelvic girdle in platycephalids in connection with their habit. Indeed, the genus *Parabembras* * closely resembles a specialized scorpaenid, *Plectrogenium* in general physiognomy, and is distinguished from it only in having slightly more depressed head, 3 preopercular spines instead of being 5, roundish pectoral fin and small actinosts (Table 3).

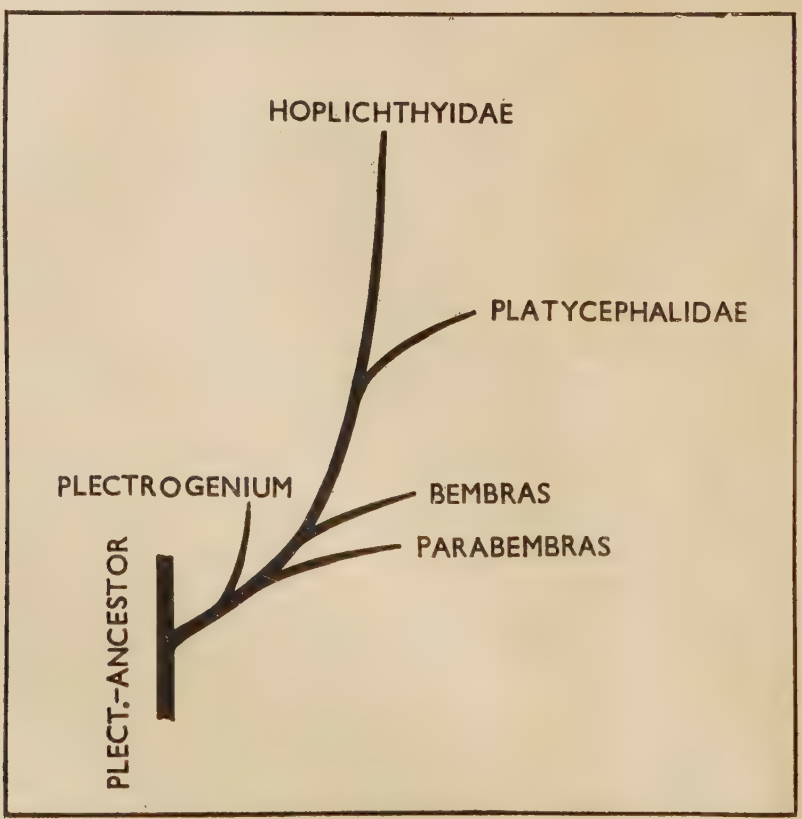

Fig. 30. Suggested phylogeny of the family Platycephalidae and its closely related families. Drawn by authors.

Because of the less depressed head, 2 to 5 preopercular spines, absence of filamentous dorsal soft rays, presence of the interoperculum, osseous mesopterygoid,

* JORDAN and HUBBS (1925, p. 281) erected are new family Parabembridae for the accommodation of *Parabembras*, but we do not hesitate to place it as a subfamily (Parabembrinae) to the family Scorpaenidae.

and ovoid otolith in members of *Parabembras*, *Bembras* and Platycephalidae, these groups appear to be more intimately related to each other than is any of them to the Hoplichthyidae (Table 3). We consider, therefore, *Parabembras* as having been stemmed from an ancestor presumably very like a specialized scorpaenid, *Plectrogenium nanum* GILBERT, and other 2 groups as having been perhaps the next to diverge from the same main stem in order *Bembras* and Platycephalidae as suggested in Fig. 30.

Although the family Hoplichthyidae is apparently more highly specialized than the Platycephalidae at least in having greatly depressed head accompanied by the reduction of the preopercular spines, largely naked body, filamentous dorsal soft rays (in males), detached pectoral rays, membranous mesopterygoid, and in lacking interoperculum, yet the family appears to have arisen directly from the same main stem as the Bembridae and Platycephalidae, but probably earlier, since the position of

Table 3. Comparison of features between *Plectrogenium*, *Parabembras*, *Bembras*, Platycephalidae, and Hoplichthyidae.

Groups / Items	*Plectrogenium*	*Parabembras*	*Bembras*	Platycephalidae	Hoplichthyidae
Head and body	Slightly depressed	Depressed	Depressed	Well depressed	Greatly depressed
Preopercular spines	5	3	5	2–5	1
Dorsal spines	Strong	Strong	Strong	Strong	Weak
Second dorsal fin (Male)	Not filamentous	Not filamentous	Not filamentous	Not filamentous	Mostly filamentous
Anal spines	3	3	Absent	Absent	Absent
Anal soft rays	5	5	11–14	11–14	16–18
Pectoral fin	Notched	Rounded	Rounded	Rounded	Lower 3 or 4 rays detached
Position of pelvic fin	Anterior	Anterior	Anterior	Posterior	Anterior
Scales	Imbricated	Imbricated	Imbricated	Imbricated	Absent except for lateral line
Interoperculum	Present	Present	Present	Present	Absent
Mesopterygoid	Osseous	Osseous	Osseous	Osseous	Membranous
Actinosts	Rather long	Short and deep	Short and deep	Short and deep	Rather long
Pelvic girdles	Fully connected	Fully connected	Fully connected	Not fully connected	Fully connected
Otolith	Ovoid	Ovoid	Ovoid	Ovoid	Circular

the pelvic fin, configuration of both pelvic girdle and actinosts of the Hoplichthyidae are almost identical with those of the *Plectrogenium* and are widely different from those of the Platycephalidae.

3. Differentiations among the Platycephalidae

The phyletic relationship within this family also does not appear to have paid much attention from systematists although many new genera and subfamilies have been erected during the past 30 years. Having gone through literature, we have recognized that about 80 species in this family have been described throughout the world. And many of the species, inclusive of various forms, are found in the Indo-Australian region. The ancestral center of dispersal for this family, therefore, would appear to be in this region. In order to show well the differentiation among the Platycephalidae in linear series, we trust that it must be examined at least all the representative forms from that region. Nevertheless, some discussion of the evolutionary pattern among the members of this family seems desirable to us here.

Summarizing all of our knowledge of the internal features on Japanese flatheads,

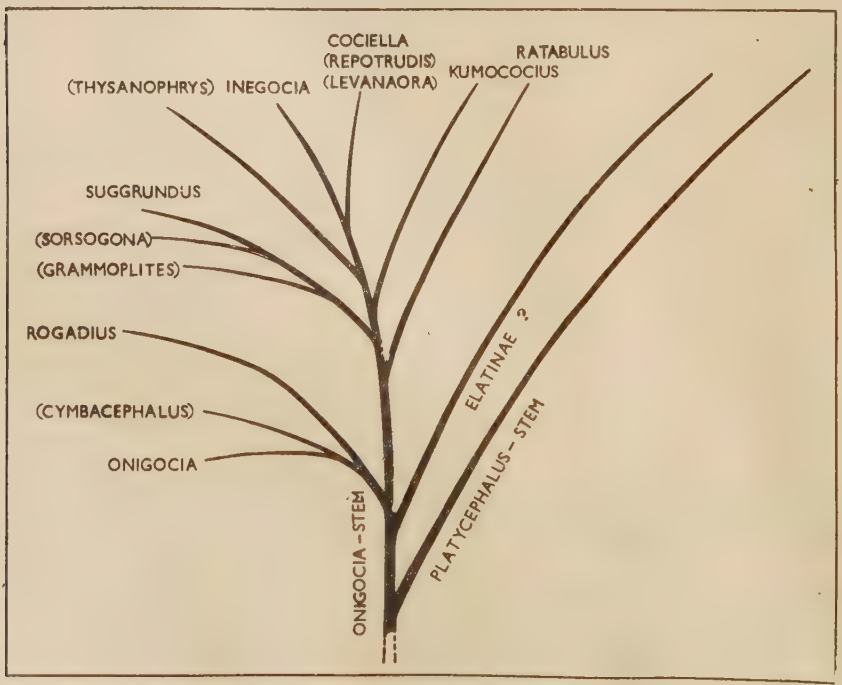

Fig. 31. Suggested phylogeny of the flatheads. The genera put in parenthesis are those not represented in Japan. Drawn by authors.

we tried to set forth Table 4, which shows similarities and differences between various genera. For convenience' sake some external features are also introduced in this table. In determining the relationship of various genera to one another, however, the internal features are particularly taken into consideration. The diversities of most of the elements of these internal organs have already been suggested in the preceding chapters.

Figure 31 indicates our present concepts of the generic relationships within the family Platycephalidae based on the features shown in Table 4. It will be seen from this figure that we divided the Japanese flatheads into 2 major groups, with Platycephalinae on the right as a specialized group, and all of the other genera on the left as a generalized one. These 2 groups are called herein as *Platycephalus*-stem and *Onigocia*-stem respectively.

Onigocia-stem :—As shown in Table 4, the *Onigocia*-stem is rather complicated, but is undoubtedly more generalized than *Platycephalus*-stem. Lower pharyngeal bone, suborbital bones, suspensorium, hyoid apparatus, cranium, shoulder girdle and pelvic girdle are all less specialized in *Onigocia*-stem than in the other. In addition to this fact the external features are also undifferentiated. The head is less depressed, the preopercular spines are usually not less than 3, the opercular spines are all preceded by a keel, and pored scales in lateral line are usually fewer than 60.

Among the *Onigocia*-stem the genera *Onigocia* and *Rogadius* should, perhaps, be considered to be most undifferentiated representatives of the Japanese flatheads, since in these genera the side of head is unicarinate and the horny process from the posterior margin of the opisthotic bone is rudimentary, as is the case with the scorpaenoid fishes, the preopercular spines are yet well developed, the scales are rather large, and the perforating duct of lateral line scales is communicated with the exterior through ends of 2 thick tubes. The first genus to depart from this stem is believed to have been the *Onigocia*, which has many scorpaenoid features. Indeed, in this genus scales are very large, pored scales in the lateral line are fewer than 40, and agree exactly with transverse rows of scales running obliquely backward and downward or forward and downward; teeth are either villiform or granular, median longitudinal keel on the preorbital bone and the anteriormost 2 suborbital bones are armed with a row of close-set sharp spines; the first suborbital bone is very narrow antero-posteriorly, never overlapping above the anterior part or the second suborbital bone; and the urohyal bone is rather deeply invested in the muscle of the isthmus, and the lower surface of this bone is deeply concave. These characteristics in *Onigocia* are all identical with those of some scorpaenoid fishes, especially in the *Plectrogenium*. The genus *Rogadius* is undoubtedly more differentiated than the genus *Onigocia*. In this genus scales are more or less smaller, pored scales in the lateral line are about 50, and agree exactly with transverse rows of scales running obliquely backward and downward, but fewer than those

running obliquely forward and downward; teeth on the vomer, palatines and pharyngeal bones are more or less enlarged, some of them are canine-like; the median longitudinal keel on the preorbital bone and the anteriormost 2 suborbital bones are armed with 3 or 4 rows of fine granules; the first suborbital bone is moderately broad antero-posteriorly, and broadly overlapping above the anterior part of the second suborbital bone; each posterior lobe of the urohyal bone is deeply incised at the outer basal part of it; and the urohyal bone is never deeply incised in the muscle of the isthmus, and the ventral aspect of this bone is moderately concave. Thus, the genus *Rogadius* is apparently more differentiated than the genus *Onigocia*, yet the former has 5 preopercular spines, inclusive of an antrorse spine on lower face of the preopercle, as is the case with most of the scorpaenoid fishes.

The Philippine genus *Cymbacephalus* (FOWLER, 1938 C, p. 90), too, should be placed in the *Onigocia*-stem. It is closely related to the genus *Onigocia* than genus *Rogadius* at least in having 3 preopercular spines and the suborbital stay is armed with a row of sharp spines. It has a conspicuous pit at the hind orbital edge and lateral line scales are all unarmed, but in other respects there are no essential peculialities.

The genera *Suggrundus*, *Inegocia*, *Cociella*, *Kumococius* and *Ratabulus* are, as a whole, apparently more differentiated than *Onigocia* at least in having smaller and more numerous scales, more depressed head, side of head bicarinate, and a well developed horny process from the posterior margin of the opisthotic bone. These features together with the reduction of the preopercular spines in most genera, which is accompanied by the depression of the head, may suggest that they are considerably removed from the scorpaenoid stock. Although these genera agree well with each other in various characteristics, they form a series showing successive specialization.

In the *Suggrundus* 3 preopercular spines are yet persistent, and the perforating duct of the lateral line scales is yet communicated with the exterior through ends of 2 thick tubes instead of a single tube, although the ridges of the cranium and suborbitial bones are well granulated and denticulated.

The genus *Inegocia* is apparently more differentiated than the genus *Suggrundus*, at least in having the preopercular spines 2 or 3, the third one, if present, is rudimentary, although the perforating duct of the lateral line scales is yet communicated with the exterior through ends of 2 tubes.

The genus *Cociella* is very much like the preceding, but the perforating duct of the lateral line scales is communicated with the exterior though a single tube.

Though the third preopercular spine from the upper is rudimentary and though the perforating duct of the lateral line scales is communicated with the exterior through a single tube in the *Kumococius*, as is the case with the precedent, the genus is peculiar in lacking the nasal flap and having the pectoral fin slightly concave instead of being rounded along the posterior margin. The genus *Kumo-*

cocius must, in our view be considered to have arisen earlier than at least either *Inegocia* or *Cociella*.

The genus *Ratabulus* seems to us to be a highly specialized offshoot among the genera of the *Onigocia*-stem. The lateral line scales and the preopercular spines are similar with those of the *Cociella* and *Kumococius*. But major differences of the *Ratabulus* from other genera of the *Onigocia*-stem are observed in the dentition, urohyal bone, suspensorium and pelvic girdle. The teeth are indeed well developed, some of them being canine-like and even depressible; the urohyal bone is strengthened by 2 pairs of the lateral keels in addition to a median stout keel; the interosseous space between the hyomandibular process and the metapterygoid lamina is entirely covered with the posterior extension of the metapterygoid bone; and the postpelvic process is bicusped. These features in the *Ratabulus* probably do not indicate the generalization, but may be due to the specialization of the genus. In characteristics of the interosseous space and the postpelvic porcess aforementioned, the *Ratabulus* resembles the *Platycephalus*, a genus of the other stem, but there is a good reason for considering that the *Ratabulus* should be placed in *Onigocia*-stem, thus, the vomerine teeth are set in 2 parallel longitudinal bands, as is the case with the genera of *Onigocia*-stem as compared with a crescentic band placed nearly transversely to the shaft of the bone in the *Platycephalus*. Apart from the vomerine teeth it is interesting to observe that the *Ratabulus* is much nearer to the genera of *Onigocia*-stem than to the *Platycephalus* in features of the preopercular spines, lower pharyngeal bones, suborbital bones, metapterygoid bone, glossohyal bone, cranium, and shoulder girdle.

Of the foreign genera the *Grammoplites* (Fowler, 1904, p. 550) and *Sorsogona* (Herre, 1934 b, p. 67) are apparently closely related to the genus *Suggrundus*, and the *Repotrudis* (Whitley, 1930, p. 27) and *Levanaora* (Whitley, 1933, p. 95) are hardly distinguishable from the genus *Cociella*. *Thysanophrys* (Ogilby, 1898, p. 40) may presumably be taken to represent one of the specialized type of this group, since the head and nape are almost naked and the scales in lateral line are enlarged and thickened, opposite being the case with other genera of this stem.

The Philippine genus *Elates* (Jordan, and Seale, 1907, p. 39), to which the Australian genus *Hyalorhynchus* (Ogilby, 1910, p. 118) is synonymized, seems to us to be a highly specialized offshoot of a line of the *Onigocia*-stem, although the characteristics of the vomerine teeth are uncertain. The genus, however, because of its depressed head, small scales and a single long saber-like preopercular spine, demonstrates externally closer relationship to the genera of *Platycephalus*-stem than those of the *Onigocia*-stem.

Platycephalus-stem : —The present stem is represented from Japanese waters by a single genus, *Platycephalus*. But an examination of the description of the Australian genera *Neoplatycephalus* (Castelnau, 1872, p. 87), *Cacumen* (Whitley,

1931a, p. 326), *Planiprora* (WHITLEY, 1931a, p. 327), *Leviprora* (WHITLEY, 1931a, p. 327), *Trudis* (WHITLEY, 1931a, p. 327), *Longitrudis* (WHITLEY, 1931a, p. 327) and *Cumbel* (WHITLEY, 1952, p. 32), and an Australian subgenus *Colefaxia* (WHITLEY, 1935b, p. 249) convinces us that it would be correct to place them together in this stem, since they are more in common with each other than with the genera of the *Onigocia*-stem in external features. But some of them appear to show close relationship with the genera of *Onigocia*-stem. Especially in *Cumbel* we have an important structural link between *Onigocia*-stem and *Platycephalus*-stem. Indeed, in *Cumbel* the head is very large (about one-third as long as the body length) and bears a rudimentary third preopercular spine as seen in some members of the *Onigocia*-stem.

So far as our observations go in *Platycephalus indicus*, the head is greatly depressed; the preopercular spines are constantly 2, enlarged and subequal or lower one is even larger; no accessory spine is present at the base of upper preopercular spine; the lower opercular spine is not preceded by a keel; pored scales in lateral line are more than 60; outer posterior part of the lower pharyngeal bone is greatly produced backward into a long lobe; the third suborbital bone is held at the anterior one-fourth of the upper border of the second suborbital bone; the suborbital sensory canal gives off a branch at the anterior one-third of the second suborbital bone, then runs upward and forward until it reaches to the third suborbital bone (Figs. 15, J; 16, B); the hyomandibular process and the metapterygoid lamina are indistinct, the interosseous space between them is entirely covered with the posterior part of the metapterygoid bone; the upper half of the metapterygoid bone is turned outward (Fig. 17, J); the rear margin of the glossohyal is roundly convex, forming 3 distinct condyles (Fig. 22, J); the postorbital part of the cranium is about 3 times as long as the orbital diameter; the postorbital rim formed by the frontal and sphenotic bones is extending forward from a vertical through the anterior margin of the prootic bone; the sphenotic bone is 3 times as long as wide; the supraorbital rim of the frontal bone is little elevated, smooth, and the supraorbital spinous ridge is deprived of its normal position and located behind the interorbital region; the window between orbits in front of the basisphenoid bone is very small (Fig. 25, E); the upper lamina of the clavicle covers nearly entire surface of the coracoids; the upper surface of the clavicle is highly keeled (Fig. 26, J); the postpelvic process is tricuspid; the postpelvic keel is armed with a spinous process which is directed inward and backward; the subpelvic keel bears a falciform process which is directed forward and slightly inward (Fig. 29, B).

From the characteristics demonstrated above we consider, in all probability, that the genus *Platycephalus* is highly differentiated than the genera of *Onigocia* stock. As a matter of interest, it should be remarked that in the genus *Platycephalus* the vomerine teeth are arranged in a crescentic band and are placed nearly

transversely to a shaft of the bone (Fig. 9, A), and the opisthotic bone bears no horny process posteriorly, as in the scorpaenoid fishes. The *Platycephalus*-stem therefore must, in our view, be considered to have arisen from the same ancestor, such as *Plectrogenium*-like stock, as in the *Onigocia*-stem but probably earlier than it, having some features in common with it, retaining some other features directly from the ancestral stock, and aquiring some peculialities of its own stem.

Table 4. Comparison of characters within the family Platycephalidae.

Species / Items	*Onigocia spinosa*; *Onigocia macrolepis*	*Rogodius asper*	*Suggrundus meerdervoorti*	*Inegocia japonica*	*Inegocia guttata*	*Cociella crocodila*	*Kumococius detrusus*	*Ratabulus megacephalus*	*Platycephalus indicus*
Dorsal spines:									
Number									
1,7 ~ 8,0.....	0	0	0	0	0	0	0	—	—
1, 8, 1.....	—	—	—	—	—	—	—	0	—
2, 7, 1.....	—	—	—	—	—	—	—	—	0
First spine									
Long	0	0	0	0	—	—	—	—	—
Short	—	—	—	—	0	0	0	—	—
Very short....	—	—	—	—	—	—	—	0	0
Second spine									
Long	0	0	0	0	0	0	—	0	—
Short	—	—	—	—	—	—	0	—	—
Very short....	—	—	—	—	—	—	—	—	0
Last spine									
Not free.....	0	0	0	0	0	0	0	—	—
Free.....	—	—	—	—	—	—	—	0	0
Pectoral fin:									
Rounded.....	0	0	0	0	0	0	—	0	0
Slightly concave	—	—	—	—	—	—	0	—	—
Head:									
Depressed and roughened	0	0	0	0	0	0	0	0	—
Greatly depressed and smooth..	—	—	—	—	—	—	—	—	0
Anterior nostril:									
With a dermal flap	0	0	0	0	0	0	0	0	0
Without a dermal flap	—	—	—	—	—	—	—	—	—
Ocular cirrus:									
Present	0	—	—	—	—	0	—	—	—
Absent	—	0	0	0	0	—	0	0	0

Table 4 (Continued)

Iris lappet:									
Round and entire	—	—	—	—	—	0	0	0	0
Round and cirrose	—	—	—	0	0	—	—	—	—
Bilobed and entire	—	0	0	—	—	—	—	—	—
Bilobed and cirrose	0	—	—	—	—	—	—	—	—
Side of head:									
Unicarinate	0	0	—	—	—	—	—	—	—
Bicarinate	—	—	0	0	0	0	0	0	0
Interopercular flap:									
Present	—	—	0	0	0	—	0	—	0
Absent	0	0	—	—	—	0	—	0	—
Lower opercular spine:									
Preceded by a keel	0	0	0	0	0	0	0	0	—
Not preceded by a keel	—	—	—	—	—	—	—	—	0
Preopercular spine:									
Number									
5 (rarely 4)	—	0	—	—	—	—	—	—	—
3 (all well developed)	0	—	0	—	—	—	—	—	—
2 or 3 (3rd rudimentary)	—	—	—	0	0	0	0	0	—
2 (enlarged, subequal)	—	—	—	—	—	—	—	—	0
Antrorse spine									
Present	—	0	—	—	—	—	—	—	—
Absent	0	—	0	0	0	0	0	0	0
Uppermost spine									
Preceded by a spine	0	0	0	0	0	0	0	0	—
Not preceded by a spine	—	—	—	—	—	—	—	—	0
Scales in lateral line:									
Number (about)									
40	0	—	—	—	—	—	—	—	—
50-60	—	0	0	0	0	0	0	0	—
More than 60	—	—	—	—	—	—	—	—	0
Spinous scales									
1-12	0	0	0	0	0	0	0	0	—
Absent	—	—	—	—	—	—	—	—	0
Branches of perforating duct									
1	—	—	—	—	—	0	0	0	0
2	0	0	0	0	0	—	—	—	—
Shape									
Quadrate	0	0	0	0	—	—	0	—	—
Rectangular	—	—	—	—	0	0	—	0	0
Dentition:									
Upper jaw teeth									

Table 4 (Continued)

Villiform or granular	0	0	0	0	0	0	0	—	0
Canine-like	—	—	—	—	—	—	—	0	—
Lower jaw teeth									
Narrow band, inner teeth canine-like	—	—	—	—	—	—	—	0	0
Broad band, inner teeth villiform	0	0	0	0	0	0	0	—	—
Vomerine teeth									
Enlarged, crescentic band	—	—	—	—	—	—	—	—	0
Canine-like, 2 longitudinal band	—	0	—	—	—	—	—	0	—
Villiform or granular, 2 longitudinal band	0	—	0	0	0	0	0	—	0
Palatine teeth									
2 rows, inner teeth enlarged	—	—	—	—	—	—	—	—	0
2 rows, canine-like	—	0	—	—	—	—	—	—	—
Band, villiform or granular	0	—	0	0	0	0	0	—	0
Band, canine-like	—	—	—	—	—	—	—	0	—
Lower pharyngeal teeth									
Villiform or granular, outer posterior lobe of band long	0	—	0	0	—	0	0	—	—
Villiform, inner posterior lobe of band long	—	—	—	—	0	—	—	—	—
Villiform, outer posterior lobe of band very long	—	—	—	—	—	—	—	—	0
Canine-like, outer posterior lobe of band long	—	0	—	—	—	—	—	0	—
Upper pharyngeal teeth									
Villiform or granular	0	—	0	0	0	0	0	—	0
Canine-like	—	0	—	—	—	—	—	0	—
Gill-rakers (discal tubercles):									
Uniserial	0	—	—	0	0	—	0	—	—
Biserial	—	0	—	—	—	—	—	0	0
Biserial or triserial	—	—	0	—	—	0	—	—	—
Suborbital bones:									
Median longtiudinal keel									
With a row of spines	0	—	—	—	—	—	—	—	—

Table 4 (Continued)

With several spines	—	—	0	0	0	0	0	0	—
With 2 or 3 rows of granules	—	0	—	—	—	—	—	—	—
With a blunt tubercle	—	—	—	—	—	—	—	—	0
Lower anterior margin of preorbital									
With 2 or 3 spines	0	—	—	—	—	—	—	0	0
Indefinitely serrated	—	0	0	—	—	—	—	—	—
Entire	—	—	—	0	0	0	0	—	—
Upper anterior margin of preorbital									
Produced	—	—	—	—	—	—	—	0	0
Not produced	0	0	0	0	0	0	0	—	—
First suborbital bone									
Conjoined with 2nd suborbital bone	0	—	—	—	—	—	—	—	—
Overlapping above 2nd suborbital bone	—	0	0	0	0	0	0	0	0
Lower half of second suborbital									
Not turned inward	—	—	0	0	0	0	0	0	0
Turned inward	0	0	—	—	—	—	—	—	—
Third suborbital is held at									
Middle of second suborbital	0	0	0	0	0	0	0	0	—
Anterior one-fourth of second suborbital	—	—	—	—	—	—	—	—	0
Suborbital sensory canal:									
Not bridged over on preorbital	0	—	—	0	—	0	0	0	—
Bridged over on preorbital	—	0	0	—	0	—	—	—	0
Suspensorium:									
Hyomandibular process (1)									
Long and distinct	0	0	0	0	0	0	0	0	—
Broad and indistinct	—	—	—	—	—	—	—	—	0
Metapterygoid lamina (2)									
Long	0	0	0	0	0	0	0	0	—
Inconspicuous	—	—	—	—	—	—	—	—	0
Interosseous space between(1) and (2)									
Not entirely covered	0	0	0	0	0	0	0	—	—

Table 4 (Continued)

Entirely covered	—	—	—	—	—	—	—	0	0
Preopercular sensory canal:									
Thickness									
Very thick	0	—	—	—	—	—	—	—	—
Moderately thick	—	0	—	—	—	—	—	—	—
Slender	—	—	0	0	0	0	0	0	0
Branches									
Rudimentary..	0	—	—	—	—	—	—	—	—
Short	—	0	—	—	—	—	—	—	—
Long	—	—	0	0	0	0	0	0	0
Opening above uppermost branch									
Present	0	0	—	0	—	—	0	0	0
Absent	—	—	0	—	0	0	—	—	—
Insertion of canal									
Simple	0	0	—	0	—	0	0	0	0
Bified	—	—	—	—	0	—	—	—	—
Ramified.....	—	—	0	—	—	—	—	—	—
Hyoid apparatus:									
Glossohyal									
Quadrangular	0	—	0	0	0	0	—	—	—
Rectangular ..	—	0	—	—	—	—	—	0	—
Fan-like	—	—	—	—	—	—	0	—	0
Posterior margin truncated (with 2 condyles)	0	0	—	—	—	—	—	—	—
Posterior margin concave (with 2 condyles)	—	—	0	0	0	0	0	0	—
Posterior margin convex (with 3 condyles)	—	—	—	—	—	—	—	—	0
Urohyal									
Narrower posteriorly	0	—	—	—	—	—	—	—	—
Wider posteriorly	—	0	0	0	0	0	0	0	0
Posterior lobe simple.....	0	—	0	0	0	0	0	0	0
Posterior lobe incised	—	0	—	—	—	—	—	—	—
With a pair of lateral keel ..	0	0	0	0	0	0	0	—	0
With 2 pairs of lateral keel..	—	—	—	—	—	—	—	0	—
Deeply invested in muscle (lower aspect deeply concave)	0	—	—	—	—	—	—	—	—
Rather deeply invested (lower aspect moderately concave)..	—	0	—	—	—	—	—	—	—
Shallowly invested (lower aspect shallowly									

Table 4 (Continued)

concave)	—	—	0	0	0	0	0	0	0
Cranium:									
Ridges on upper surface									
Spined.....	0	—	—	0	0	0	—	0	—
Granulated....	—	0	0	—	—	—	0	—	—
Nearly smooth	—	—	—	—	—	—	—	—	0
Postorbital length									
Shorter than twice diameter of orbit	0	0	0	0	0	0	0	0	—
About 3 times diameter of orbit	—	—	—	—	—	—	—	—	0
Width									
Wider than postorbital part..	0	0	0	—	—	—	0	—	—
Narrower than postorbital part	—	—	—	0	0	0	—	0	0
Vomer									
Not dilated outward anteriorly	0	0	0	0	0	0	0	0	—
Strongly dilated outward anteriorly	—	—	—	—	—	—	—	—	0
Sphenotic									
Not elongate..	0	0	0	0	0	0	0	0	—
Elongate.....	—	—	—	—	—	—	—	—	0
Window between orbits									
Large	0	0	0	0	0	0	0	0	—
Very small....	—	—	—	—	—	—	—	—	0
Horny process of opisthotic bone									
Absent	—	—	—	—	—	—	—	—	0
Rudimentary..	0	0	—	—	—	—	—	—	—
Long	—	—	0	0	0	0	0	0	—
Ventral process of basisphenoid									
Short and free at tip	0	—	—	—	—	—	—	0	—
Long and free at tip	—	—	—	—	—	—	—	—	0
Meeting parasphenoid.....	—	0	0	0	0	0	0	—	—
Shoulder girdle:									
Supraclavicle									
Large	0	0	0	—	—	—	—	—	—
Rather small..	—	—	—	0	0	0	0	0	0
Outer anterior process of clavicle									
Roundly produced basally....	0	—	—	—	—	—	—	—	—
Not roundly produced	—	0	0	0	0	0	0	0	0
Upper lamina of clavicle									
Covers anterior 1/3 of coracoids	0	—	—	—	—	—	—	—	—
Covers anterior half of coracoids	—	0	0	0	0	0	0	0	—

Table 4 (Continued)

Covers entire surface of coracoids	—	—	—	—	—	—	—	—	0
Keels on upper lamina of clavicle									
Feeble	0	—	—	—	—	—	—	—	—
Low	—	0	0	0	0	0	0	0	—
Very high	—	—	—	—	—	—	—	—	0
Lower lamina of clavicle (at middle part)									
Conically produced	0	0	0	0	0	0	0	0	—
Never produced	—	—	—	—	—	—	—	—	0
Actinosts									
Small	0	0	0	0	0	0	0	0	—
Very small	—	—	—	—	—	—	—	—	0
Pelvic girdle:									
Postpelvic process									
simple	0	0	0	0	0	0	0	—	—
Bicuspid	—	—	—	—	—	—	—	0	—
Tricuspid	—	—	—	—	—	—	—	—	0
Postpelvic keel									
Roundish in outline	0	0	0	0	0	0	0	0	—
Produced into a spine	—	—	—	—	—	—	—	—	0
Subpelvic keel									
Roundish in outline	0	0	0	0	0	0	0	0	—
With a falciform process	—	—	—	—	—	—	—	—	0
Upper anterior angle of suprapelvic keel									
Right angle	0	0	—	—	—	—	—	—	—
Obtuse angle	—	—	0	0	0	0	0	0	0

VI. Taxonomy

The following key, which is mainly based upon the external features, involves most of the known genera of the family Platycephalidae. Those genera marked with an asterisk were examined on the basis of the published description. In the following key, the Rogadiinae (JORDAN and HUBBS, 1925, p. 286) and Cymbacephalinae (FOWLER, 1938c, p. 89) were provisionally united under the Onigociinae (JORDAN and HUBBS, 1925, p. 285), and the Thysanophrynae (WHITLEY, 1931b, p. 175) and Grammoplitinae (FOWLER, 1938c, p. 89) were placed under the Inegociinae (JORDAN and HUBBS, 1925, p. 286).

Key to subfamilies and genera of Platycephalidae

1a.—Vomerine teeth in 2 parallel longitudinal bands; head moderately depressed, usually armed

with strong spines or granules.

2a.—Preopercular spines 2 to 5, the uppermost one the largest, preceded by an accessory spine at the base; pored scales in lateral line fewer than 60; fin-rays united by membrane along their whole length; caudal rounded or truncated, none of the rays prolonged into a filament.

3a.—**(Onigociinae)** Side of head unicarinate (Fig. 15, A–C); horny process from posterior margin of opisthotic bone rudimentary at least in Japanese forms (Fig. 24, A–C).

4a.—No antrorse spine on lower face of preopercle; 3 distinct spines at angle of preopercle (Fig. 18, B·C); median longitudinal keel on preorbital and anteriormost 2 suborbital bones not granulated, but denticulated (Fig. 15, A·B); pored scales in lateral line about 40 to 50; at least a dermal flap above eye (Fig. 1, A·B); iris lappet bilobed and finely cirrose at least in Japanese forms (Fig. 2, I·J); teeth either villiform or granular, those on palatine in a broad band (Figs. 6, C·D; 8, C·D; 9, E·F; 10, D·E; 11, G·H; 12, A·B); discal tubercles on first gill-arch uniserial at least in Japanese forms (Fig. 13, A·B); first suborbital bone never overlapping above anterior part of second suborbital bone in Japanese forms (Fig. 15, A·B); each posterior lobe of urohyal simple in Japanese forms (Fig. 22, A·B).

5a.—No pit behind eye; pored scales in lateral line fewer than 40, the anterior 2 to 11 scales armed with upstanding spines; orbit with a well-developed cirrus..... ..... *Onigocia* (= syn. *Wakiyus*)

5b.—A large deep pit behind each eye; pored scales in lateral line about 50, unarmed; several conspicuous dermal flaps above eye and a tentacle on lower eyelid..... ..... *Cymbacephalus* *

4b.—A stout antrorse spine on lower face of preopercle and 4 spines at angle (Fig. 18, A); median longitudinal keel on preorbital and anteriormost 2 suborbital bone armed with 2 or 3 rows of fine granules (Fig. 15, C); pored scales in lateral line about 50; ocular cirrus absent; iris lappet bilobed, but never cirrose (Fig. 2, H); teeth on vomer, palatines and pharyngeals enlarged, some of them canine-like, palatine teeth in 2 rows (Figs. 9, C; 10, B; 11, C; 12, D); discal tubercles on first gill-arch irregularly biserial (Fig. 13, F); first suborbital bone broadly overlapping above anterior part of second suborbital bone (Fig. 15, C); each posterior lobe of urohyal deeply incised at outer basal part of it.... *Rogadius*

3b.—**(Inegociinae)** Side of head bicarinate (Fig. 15, D–I); horny process from posterior margin of opisthotic bone well developed, extending beyond rear end of parietal (Figs. 24, D–E; 25, A–D).

6a.—Head and nape scaly; no enlarged and thickened scales in lateral line; orbit without cirrus; bony stay of cheek armed with spines.

7a.—Scales moderate in size; pored scales in lateral line about 50, all armed with a spine..... *Grammoplites*[1)]

7b.—Scales of moderate to small size; pored scales in lateral line largely smooth, becoming weakly spined toward head.

8a.—Teeth either villiform or granular, mostly in broad band on jaws, vomer, palatines and pharyngeals; last dorsal spine connected with penultimate one by membrane; caudal rounded; postpelvic process simple (Fig. 28); urohyal strengthened by a pair of lateral keel in addition to a median stout keel (Fig. 22); interosseous space between hyomandibular process and metapterygoid lamina not wholly covered with posterior part of metapterygoid (Fig. 17).

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1) In *Platycephalus scaber* LINNÉ, the genotype of the genus *Grammoplites* FOWLER, according to DAY (1889, p. 236, fig. 86), the side of head is apparently bicarinate, and pored scales in lateral line are, as defined by FOWLER (1904, p. 550; 1938, p. 89), all armed with a spine. While in *Platycephalus pristis* PETERS, which was referred to *Grammoplites* by FOWLER (1935, p. 398, figs. 30·31), the lateral line is armed only first 7 or 8 scales and side of the head appears to be unicarinate.

9a.—Upper side of head well granulated and denticulated (Figs. 24, E; 15, D); preopercular spines 3, distinct and well developed at all ages (Fig. 18, D); iris lappet bilobed, but not cirrose at least in Japanese species (Fig. 2, G); perforating duct of lateral line scales communicated with exterior through ends of 2 thick tubes at least in Japanese species (Fig. 4, C).

10a.—Interopercular flap absent ..... *Sorsogona**

10b.—Interopercular flap present ..... *Suggrundus*

9b.—Upper side of head not granulated (top of head more or less granulated in *Kumococius*) (Figs. 25·26); preopercular spines 2 or 3, the third one from upper, if present, rudimentary (Fig. 19); iris lappet not bilobed at least in Japanese forms (Fig. 2).

11a.—Anterior nostril with a dermal flap; posterior margin of pectoral roundish; second dorsal spine about as long as third one (Pl. 1).

12a.—Interopercular flap present (Fig. 3, B·D); uppermost preopercular spine but little longer than second spine (Fig. 19, H·I); iris lappet cirrose (Fig. 2, E·F); perforating duct of lateral line scales communicated with exterior through ends of 2 tubes (Fig. 5, E·F) ..... *Inegocia*

12b.—Interopercular flap absent (Fig. 3, J); iris lappet not cirrose at least in Japanese form (Fig. 2, C); perforating duct of lateral line scales communicated with exterior through end of a single slender tube at least in Japanese forms (Fig. 5, H).

13a.—Uppermost preopercular spine prolonged into a bayonet-shape, much longer than second spine (Fig. 19, G); caudal rounded ..... *Cociella*; *Repotrudis**

13b.—2 preopercular spines subequal in length; caudal truncated ..... *Levanaora**

11b.—Nasal flap absent; posterior margin of pectoral slightly concave; second dorsal spine much shorter than third one (Pl. 2); uppermost preopercular spine enlarged into a bayonet-shape and much longer than second one (Fig. 19, E); interopercular flap present (Fig. 3, A); perforating duct of lateral line scales communicated with exterior through end of a single tube (Fig. 5, G) ..... *Kumococius*

8b.—Teeth highly specialized, in broad band on upper jaw, palatine and pharyngeals, in 3 or 4 series on lower jaw, and in about 3 series on vomer; some of the teeth canine-like and even depressible (Figs. 6, B; 8, B; 9, B; 10, J; 11, B; 12, E); last dorsal spine minute, free from the penultimate one; caudal truncated; postpelvic process bicuspid (Fig. 29, A); urohyal strengthened by 2 pairs of lateral keels in addition to a median stout keel (Fig. 22, H); interosseous space between hyomandibular process and metapterygoid lamina entirely covered with posterior part of metapterygoid (Fig. 17, I) ..... *Ratabuls*

6b.—Head and nape almost naked; scales in lateral line enlarged and thickened, but not spiny; orbit with a tentacle; bony stay of cheek without spines; several small preopercular spines ..... *Thyscnophrys**

2b.—**(Elatine)** A single long saber-like spine at angle of preopercle, not preceded by an accessory spine at base; scales small, those in lateral line about 125; most of dorsal and anal rays connected by membrane merely at their bases; caudal slightly forked, the upper lobe prolonged into a filament ..... *Elates** (=syn. *Hyalorhynchus**)

1b.—**(Platycephalinae)** Vomerine teeth in a crescentic band, placed nearly transversely to shaft of the bone (Fig. 9, A); head greatly depressed, nearly smooth; preopercular spines 2 (3 in *Cumbel*), enlarged, subequal or the lower one even longer; no accessory spine at base of upper preopercular

spine (Figs. 17, J; 19, J); pored scales in lateral line greater than 60, all smooth (Table 1).
14a.—Head about one-third length of body; a small third preopercular spine.....*Cumbel**
14b.—Head smaller than one-third length of body; no small third preopercular spine.
15a.—Jaws, vomer and palatines with large canines....*Neoplatycephalus**; *Cacumen**; *Colefaxia**
15b.—Jaws, vomer and palatines without canines.
16a.—Upper surface of head with some exposed bony ridges.
17a.—Teeth not uniform, some on premaxillary symphysis, vomer and palatines more or less enlarged (Figs. 6, A; 9, A; 10; A); lower preopercular spine not especially enlarged (Figs. 17, J; 19, J); interorbital space usually broader than transverse diameter of eye .....
..... *Platycephalus*; *Planiprora**
17b.—Teeth small and of uniform size; lower preopercular spine considerably longer than upper (more than twice as long as the upper in some species).....*Trudis**; *Longitrudis**
16b.—No exposed bony ridges on upper surface of head; eye larger than width of interorbital space ..... *Leviprora**

Genus *Onigocia* Jordan and Thompson

Onigocia Jordan and Thompson, 1913, p. 70 (type by original designation *Platycephalus macrolepis* Bleeker).
Wakiyus Jordan and Hubbs, 1925, p. 286 (type by original designation *Platycephalus spinosus* Temminck and Schlegel).

Ocular cirrus well developed (Fig. 1); iris lappet bilobed and finely cirrose (Fig. 2, I•J). Anterior nostril with a dermal flap posteriorly. Interopercular flap absent (Fig. 3, G•H). Scales large; pored scales in lateral line fewer than 40, and agree exactly with transverse rows of scales running obliquely backward and downward or forward and downward (Table 1); pored scales quadrate, spined anteriorly; the perforating duct robust, communicated with exterior through ends of 2 thick tubes (Fig. 4, A•B).

Teeth either villiform or granular, forming a broad band on jaws, vomer, pa-la tines and pharyngeals; vomerine teeth in 2 parallel longitudinal bands (Figs. 6, C •D; 8, C•D; 9, E•F; 10, D•E; 11, G•H; 12, A•B). Gill-rakers on first arch 1+3 to 5=4 to 6 (Table 2); discal tubercles on the arch moderately large, uniserial and interpolated between gill-rakers (Fig. 13, B•C). Lower half of second suborbital bone below median longitudinal keel turned inward at right angle, lower border of the bone reaches to under side of head, thus, side of head unicarinate; median longitudinal keel on preorbital and anteriormost 2 suborbital bones armed with a row of close-set sharp spines; lower anterior margin of preorbital bone armed with 2 or 3 sharp antrorse spines; first suborbital bone conjoined with anterior border of second suborbital bone; hindmost branch of suborbital sensory organ not bridged over on posterior part of preorbital bone (Figs. 15, A•B; 16•C). Hyomandibular process and metapterygoid lamina well developed, interosseous space between them not wholly covered with posterior part of metapterygoid bone; posterior half of metapterygoid turned outward. Preopercular spines 3, all distinct; no antrorse spine; a sharp accessory spine at base of uppermost preopercular spine. 2 pungent

opercular spines, each preceded by a stout keel. Preopercular sensory canal very thick, widely opens between the first branch and upper insertion of the canal; branches of the canal scarcely developed except for moderately long first branch (Figs. 17. A•B; 18, B•C; 20, A). Glossohyal quadrangular, the posterior margin truncated. Urohyal deeply invested in muscle of isthmus, and lower aspect of the bone deeply concave; the bone becomes gradually narrower posteriorly and the posterior margin shallowly concave (Figs. 22, A•B; 23, A). Cranium armed with strong spines; postorbital region of cranium much wider than long, and much shorter than twice diameter of orbit; horny process from posterior margin of opisthotic bone rudimentary; ventral process of basisphenoid very short, free from paraspbenoid; supraorbital rim elevated, armed with a series of strong spinous ridge (Fig. 24, A•B). Upper lamina of clavicle covering only anterior one-third of coracoids (Fig. 26, A•B). Postpelvic process simple; postpelvic and subpelvic keels also simple; suprapelvic keel forming a right angle at upper anterior extremity (Fig. 27, A•B).

Remarks.— There seems to be no clear dividing line to distinguish the *Wakiyus* JORDAN and HUBBS from the present genus. The differences found in the armature of both lateral line scales and head are, in our opinion, all specific (See the following key). This being so, we have been unable to retain the *Wakiyus* as a distinct genus.

Besides 2 species known in Japan, 3 Indian species, *Platycephalus oligolepis* REGAN (REGAN, 1908, p. 238, pl. 29, fig. 4), *Platycephalus pedimacula* REGAN, (REGAN, 1908, p. 238) and *Platycephalus grandisquamis* REGAN (REGAN, 1908, p. 239) may presumably be referred to the present genus.

Key to the species of the genus *Onigocia*

1a.—Scales adhesive: anterior 8 to 11 scales in lateral line armed with a spine (Table 1). Antorbital margin armed with 3 antrorse spines; suborbital spinous ridge not deeply incised below middle of eye (Fig. 15, B). Supraorbital rim armed with a series of spines throughout the entire length; anterior margin of orbit armed with a row of several small spines (Fig. 24, B). Head longer, 2.1 to 2.9 in body length. Pelvic fin reaching below base of about fifth dorsal soft ray. Back of body crossed with about 5 distinct dark brown bars; upper half of pectoral fin with about 6 cross bars, distal two-thirds of lower half of the fin blackish; middle part of pelvic fin blackish, other parts of the fin pale; caudal fin cross with 4 bars of dusky ..... *O. spinosa*

1b.—Scales deciduous; anterior 2 to 4 scales in lateral line spined (Table 1). Antorbital margin armed with 2 antrorse spines; suborbital spinous ridge deeply incised below middle of eye (Fig. 15, A). Anterior half of supraorbital rim entirely smooth; anterior margin of orbit armed with a pungent preocular spine (Fig. 24, A). Head smaller, 2.8 to 3.1 in body length. Pelvic fin reaching below base of about first dorsal soft ray. Back of body crossed with about 5 very indefinite dark brown bars; pectoral and pelvic fins with several narrow dark bars; caudal fin pale..... *O. macrolepis*

Onigocia spinosa (TEMMINCK and SCHLEGEL)

Platycephalus spinosus TEMMINCK and SCHLEGEL, 1842, p. 40, pl. 16, figs. 1•2, Nagasaki (original

description).——Richardson, 1846, p. 217, China (notes).——Bleeker, 1854–1857, p. 77, Nagasaki (description).——Günther, 1860, p. 190, Japan (description).——Rutter, 1897, p. 82, Swato, China (description).——Ishikawa and Matsuura, 1897, p. 48, Hatsuzima, Izu (listed).——Boeseman, 1947, p. 50 (revision of *Platycephalus spinosus* of Temminck and Schlegel, 1843).

Insidiator spinosus Jordan and Seale, 1906, p. 380 (distribution).——McCulloch, 1929, p. 404, Queensland, Australia (listed).

Insidiator macrolepis (not *Platycephalus macrolepis* of Bleeker) Smith and Pope, 1906, p. 487, Kagoshima; Yamagawa (diagnosis).

Thysanophrys spinosus Jordan and Richardson, 1908, p. 633, Fig. 2, Nagasaki (description).——Franz, 1910, p. 77, Misaki; Fukuura (notes). ——Snyder, 1912a, p. 434, Shimizu (notes). ——Fujita and Wakiya, 1915, p. 12, Kisyû (listed).——Izuka and Matsuura, 1920, p. 123, Tateyama, Chiba Prefecture (listed). ——Fowler, 1928, p. 301 (diagnosis; distribution). ——Ui, 1929, p. 235, Kisyû (diagnosis).——Tanaka, 1931, p. 37 (listed).——Kuroda, 1931, p. 119, Shizuura, Suruga Bay (listed). ——Scemidt, 1931b, p. 117, Nagasaki (notes).——Kamohara, 1936, p. 3, Tosa (notes). ——Koike, 1936, p. 12, Fukui Prefecture (listed). ——Uchida and Yabe, 1939, p. 12, Quelpart Island, Korea (listed). ——Kamohara, 1938, p. 50, Prov. Tosa (notes). ——Katayama, 1940, p. 19, Toyama Bay (listed).——Kuroda, 1951, p. 381, Suruga Bay (distributional note).——Kamohara, 1952, p. 70, Prov. Tosa (note).

Onigocia spinosa Jordan and Thompson, 1914, p. 278, fig. 50, Misaki (listed).

Wakiyus spinosus Jordan and Hubbs, 1925, p. 287 (notes).——Okada, Uchida and Matsubara, 1935, p. 221, pl. 128, fig. 1, Tokyo market (description; distribution).——Okada and Matsubara, 1938, p. 333 (Key; distribution). ——Katayama 1950, p. 9, China Sea (listed). ——Honma, 1952, p. 223, Niigata Prefecture (listed).——Mori, 1952, p. 160, Tongyong and Quelpart Island, Korea (listed).

Thysanophrys spinosus Evermann and Shaw, 1927, p. 119, Ningpo, eastern China (description).

Thysanophrys (*Wakiyus*) *spinosus* Schmidt, 1931a, p. 116, Misaki; Nagasaki; Kagoshima (notes).

Suggrundus spinosus Fowler, 1949, p. 109 (listed).

Material described.——No. 15036 (the numbers refer to Matsubara's Fish Collection, in which each specimen bears a separate number), 92.5 mm. in standard length (113.0 mm. in total length), Maisaka, Shizuoka Pref.——Nos. 15016–15035, 24.5–97.0 mm. (30.5–114.5 mm.), Saheki Bay, Ôita Pref., January 3, 1951.——Nos. 15244–15245, 65.0–80.0 mm. (78.0–97.0 mm.), off Owashi, Kumano-nada, January 20, 1951.——Nos. 16047–16049, 46.0–83.0 mm. (57.0–104.0 mm.), off Owashi, March 7, 1951, ——Nos. 17173–17179, 51.0–97.0 mm. (62.0–114.5 mm.), off Owashi, January 8–11, 1951.——No. 17784, 77.0 mm. (94.5 mm.), off Owashi, March 5, 1952.

Description.—The following counts and measurements (followed by the averages in parentheses) are based upon 34 specimens ranging from 24.5 to 97.0 mm. in standard length.

Dorsal spines 1, 8 (1, 8); dorsal soft rays 11 to 12 (11.94); anal rays 12 (12); pectoral fin rays 20 to 22 (21.07). Gill-rakers on first arch 1+3 to 5=4 to 6 (5.02). Pored scales in lateral line 35 to 42 (37.09). Pyloric coeca 5 (5). Measurement divided into standard length: greatest body depth 5.18 to 7.70 (6.24); greatest body width 4.58 to 6.00 (4.85); head length 2.21 to 2.89 (2.55); depth of caudal peduncle 15.00 to 20.50 (17.71). Measurement divided into head length: snout length 3.00 to 4.50 (3.77); eye diameter 3.00 to 4.50 (3.71); interorbital width 11.26 to 18.50 (13.92); upper jaw length 2.10 to 3.33 (2.58); pectoral fin length 1.64 to 2.45 (2.04); pelvic fin length 1.18 to 1.85 (1.48); dorsal first spine

3.42 to 8.80 (6.37); dorsal second spine 2.45 to 3.69 (2.62); dorsal first soft ray 2.45 to 4.20 (3.04); dorsal second soft ray 2.03 to 3.00 (2.34).

Remarks.—*Insidiator macrolepis* of SMITH and POPE (not *Platycephalus macrolepis* of BLEEKER) is apparently identical with the present species, as suggested, as early as 1908, by JORDAN and RICHARDSON. *Platycephalus oligolepis* of REGAN (1908, p. 238, pl. 29, fig. 4), which should go as *Onigocia oligolepis*, is apparently more closely related to the present species than to *Onigocia macrolepis* (BLEEKER) at least in having a series of spines throughout the entire length of the supraorbital ridge and 3 spines in front of each orbit, but it is sharply distinguished from the present species at least in having a fewer number of scales in the lateral line (31 as compared to 35 to 42 in the present species) and fewer number of armed scales in the lateral line (3 or 4 as compared to 8 to 11 in the present species). *Onigocia pedimacula* (REGAN) and *O. grandisquamis* (REGAN) are nearer *O. macrolepis* (BLEEKER) than the present species, as will be seen later on.

Onigocia macrolepis (BLEEKER)

Platycephalus macrolepis BLEEKER, 1854, p. 399, Nagasaki (original description).——GÜNTHER, 1860, p. 188, Japan (description).——NYSTRÖM, 1887, p. 26, Japan (description).——STEINDACHNER and DÖDERLEIN, 1887, p. 260, Tokyo (description).

Insidiator hosokawae SMITH and POPE, 1906, p. 486, fig. 8, Urado, Shikoku (original description).

Thysanophrys macrolepis FRANZ, 1910, p. 68, Aburatsubo, Misaki (listed).——SNYDER, 1912a, p. 434, Shimizu (listed).——UI, 1929, p. 235, Kisyû (diagnosis).——TANAKA, 1931, p. 37 (listed).——KOIKE, 1936, p. 12, Fukui Prefecture (listed).——KURODA, 1947, p. 30, off Senbon, Suruga Bay (notes).——KURODA, 1951, p. 381, Suruga Bay (distributional note).——KAMOHARA, 1952, p. 70, Prov. Tosa (notes).

Onigocia macrolepis JORDAN and THOMPSON, 1913, p. 70, Shikoku (discussion).——JORDAN and THOMPSON, 1914, p. 278, Misaki; Yahatahama, Shikoku (listed).——JORDAN and HUBBS, 1925, p. 287, Misaki (listed).——OKADA and MATSUBARA, 1938, p. 333 (key; distribution).——MAKO, 1949, p. 133, East China Sea; Yellow Sea (listed).——LIANG, 1951, p. 30, Taiwan (listed).

Material described.——Nos. 1198, 1244 and 2150 (MATSUBARA's Fish Collection), 78.0–90.0 mm. in standard length (92.0–108.0 mm. in total length), off Owashi, Knmano-nada, February 5, 1935.——Nos. 2221–2222, 81.0–107.5 mm. (98.0–127.5 mm.), off Owashi, January 5, 1936.——No. 4620, 88.0 mm. (103.5 mm.), off Owashi, January, 1937.——No. 8364, 105.0 mm. (128.0 mm.), off Kanaiwa, Ishikawa Pref., October 26, 1942.——Nos. 10120–10121, 10125, 10128, and 10130–10132, 87.0–118.0 mm. (103.5–142.0 mm.), off Maisaka, Shizuoka Pref., February, 1948.——No. 10175, 102.0 mm. (127.0 mm.), off Kasumi, Hyogo Pref., March 28, 1948.——No. 12175, 88.0 mm. (106.0 mm.), East China Sea, October, 1949.——Nos. 13017–13018, and 13021, 99.0–107.8 mm. (121.0–128.0 mm.), off Maizuru, Kyoto Pref., May, 1950.——Nos. 14070–14071, and 14075–14078, 65.5–104.0 mm. (80.0–123.0 mm.), off Maizuru, September 14, 1950.——Nos. 14219–14240, 14339, 14341, and 14479–14488, 78.6–113.0 mm. (94.0–136.0 mm.), East China Sea, October, 1950.——No. 14595, 90.0 mm. (111.0 mm.), off Nobeoka, Miyazaki Pref., November, 1950.——Nos. 14727, and 14807–14810, 90.0–111.0 mm. (107.5–133.0 mm.), East China Sea, November, 1950.——Nos. 15246, and 15248–15249, 71.0–118.0 mm. (86.0–141.0 mm.), off Owashi, January 15, 1951.——No. 16063, 103.0 mm. (126.0 mm.), off Maizuru, February 10, 1951.——No. 18049, 118.0 mm. (140.0 mm.), off Maisaka, Shizuoka Pref.——Nos. 18050–18053, 93.0–106.0 mm. (112.0–128.0 mm.), off Niigata, Niigata Pref.

Description.—The counts and measurements (followed by averages in parentheses) of these 74 specimens run as follows:

Dorsal spines 1, 7 to 8 (1, 7.64); dorsal soft rays 11 to 12 (11.32); anal rays 12 (12); pectoral fin rays 20 to 22 (20.41). Gill-rakers on first arch 1+3 to 5=4 to 6 (4.85). Pored scales in lateral line 35 to 42 (37.50). Pyloric coeca 5 (5). Measurement divided into standard length: greatest body depth 5.51 to 8.25 (6.67); greatest body width 4.30 to 5.61 (4.71); head length 2.76 to 3.10 (2.91); depth of caudal peduncle 15.80 to 21.60 (17.60). Measurement divided into head length: snout length 3.38 to 4.54 (3.64); eye diameter 3.47 to 4.63 (3.85); interorbital width 9.86 to 16.00 (11.92); upper jaw length 2.25 to 2.96 (2.54); pectoral fin length 1.80 to 2.48 (2.05); pelvic fin length 1.40 to 1.72 (1.54); dorsal first spine 6.45 to 13.40 (9.63); dorsal second spine 2.00 to 3.41 (2.65); dorsal first soft ray 2.35 to 3.77 (2.90); dorsal second soft ray 1.93 to 2.76 (2.28).

Remarks.—*Insidiator hosokawae* of Smith and Pope is apparently a synonym of the present species, as suggested, as early as 1908, by Jordan and Richardson. The present species is rather closely related to *Onigocia spinosa*, with which it is compared in the analytical key. The Indian species, *Platycephalus pedimacula* of Regan (1908, p. 238), which should go as *Onigocia pedimacula*, is apparently closely related to the present species rather than *O. spinosa* at least in having the supraorbital ridge unarmed anteriorly, but it may be distinguished from the present species among other things by having about 30 scales, as compared to 35 to 42 in the present species, in the lateral line, and 5 spines, instead of being a single in the present species, in front of each orbit. *Platycephalus grandisquamis* of Regan (1908, p. 239), which also should go as *Onigocia grandisquama*, can hardly be distinguished from the present species except for having 30 scales, as compared to 35 to 42 in the present species, in the lateral line.

Genus *Rogadius* Jordan and Richardson

Rogadius Jordan and Richardson, 1908a, p. 930 (type by original designation *Platycephalus asper* Cuvier and Valenciennes).

Ocular cirrus absent; iris lapped bilobed, but never cirrose (Fig. 2, H). Anterior nostril with a dermal flap posteriorly. Interopercular flap absent (Fig. 3, F). Scales moderate in size; pored scales in lateral line about 50, and exactly agree with transverse rows of scales running obliquely backward and downward, but much fewer than those running obliquely forward and downward (Table 1); pored scales quadrate, spined anteriorly; the perforating duct robust, communicated with exterior through ends of 2 thick tubes (Fig. 4, C).

Teeth on jaws either villiform or granular, in broad band; those on vomer, pharyngeals enlarged, some of them canine-like; palatine teeth in 2 rows; vomerine teeth in 2 parallel longitudinal bands (Figs. 6,E; 8,E; 9,C; 10,B; 11,C; 12,D). Gill-

rakers on first arch 1+6 to 7=7 to 8 (Table 2); discal tubercles on the arch large, irregularly biserial, and interpolated between gill-rakers (Fig. 13, F). Lower half of second suborbital bone below median longitudinal keel turned inward at right angle, lower border of the bone reaches to under side of head, thus, side of head unicarinate; median longitudinal keel on preorbital and anteriormost 2 suborbital bones armed with 2 or 3 rows of fine granules; lower anterior margin of preorbital bone indefinitely serrated; first suborbital bone broadly overlapping above anterior part of second suborbital bone; hindmost branch of suborbital sensory organ bridged over on posterior part of preorbital bone (Figs. 15, C; 16, A). Hyomandibular process long; metapterygoid lamina distinct; interosseous space between them not wholly covered with posterior part of metapterygoid bone; posterior half of metapterygoid bone turned outward. Preopercle armed with an antrorse spine on lower face and 4 spines at angle, the lowermost of the latter rudimentary and the uppermost one much longer than second one from the upper; a sharp accessory spine at base of uppermost preopercular spine. 2 pungent opercular spines, each preceded by a stout keel. Preopercular sensory canal moderately thick, widely opens between first branch and upper insertion of this organ; branches of the canal short, but distinct (Figs. 17, C; 18, A). Glossohyal rectangular, the rear margin truncated. Urohyal becomes gradually wider posteriorly and the posterior margin deeply concave; each posterior lobe of urohyal deeply incised at outer basal part of it; lower aspect of urohyal moderately concave (Figs. 22, C; 23, B). Cranium finely and thickly granulated; postorbital region of cranium much wider than long, and much shorter than twice diameter of orbit; supraorbital rim of frontal bone armed with a series of granular spines; horny process from posterior part of opisthotic bone rudimentary; ventral process of basisphenoid well developed, the tip meeting parasphenoid (Fig. 24, C). Upper lamina of clavicle covers anterior half of coracoids (Fig. 26, C). Postpelvic process simple; postpelvic and subpelvic keels also simple; suprapelvic keel forming a right angle at upper anterior extremity (Fig. 27, C).

Remarks.—The present genus is closely related to the genus *Onigocia* at least in having the side of the head unicarinate, rudimentary horny process from posterior part of the opisthotic bone, and the suprapelvic keel forming the right angle at the upper anterior extremity, but it is distinguished from the latter in the following characteristics: 1) preopercle is armed with an antrorse spine on the lower face and 4 spines at the angle, the lowermost one of the latter is rudimentary, 2) pored scales in the lateral line are about 50, and they are fewer than transverse rows of scales running obliquely forward and downward, 3) the ocular cirrus is absent, 4) the iris lappet is bilobed, but never cirrose, 5) teeth on the vomer, palatines and pharyngeals are enlarged, some of them are canine-like; palatine teeth are set in 2 rows, 6) discal tubercles on the first gill-arch are set in irregularly biserial, 7) the median longitudinal keel on the preorbital and suborbital bones is armed with 2 or 3 rows

of fine granules; the lower margin of the preorbital bone is indefinitely serrated; the first suborbital bone is broadly overlapping above anterior part of the second suborbital bone; hindmost branch of the suborbital sensory canal is bridged over on posterior part of the preorbital bone, 8) the preopercular sensory canal is slender, the branches are short, but distinct, 9) the glossohyal bone is rectangular in shape, 10) the urohyal bone becomes gradually wider posteriorly and the rear margin is deeply concave; each posterior lobe of the urohyal bone is deeply incised at outer basal part of it; lower aspect of the urohyal bone is moderately concave, 11) the cranium is finely and thickly granulated; ventral process of the basisphenoid is well developed, and the tip is meeting upper surface of the parasphenoid, and 12) upper lamina of the clavicle covers anterior half of the coracoids.

2 species, *Rogadius asper* (CUVIER and VALENCIENNES) and *R. Pristiger* (CUVIER and VALENCIENNES), are referred to the present genus, of which the former is known in Japan.

Rogadius asper (CUVIER and VALENCIENNES)

Platycephalus asper CUVIER and VALENCIENNES, 1829, P. 257, Japan (original description).——TEMMINCK and SCHLEGEL, 1842, p. 40, pl. 16, figs. 4·5 (notes, after CUVIER and VALENCIENNES).——RICHARDSON, 1846, p. 217, Canton (notes).——GÜNTHER, 1860, p. 190, Japan and China (description).——STEINDACHNER and DÖDERLEIN, 1887, p. 261, Ôshima (diagnosis).——RUTTER, 1897, p. 83, Swatow, China (description).——ISHIKAWA and MATSUURA, 1897, p. 48, Kagoshima (listed),——BORODIN, 1930, p. 59, Manila (listed).——ROXAS and MARTIN, 1937, p. 181, Luzon; Manila (listed).——BOESEMAN, 1947, p. 50 (revision of *Platycephalus asper* of TEMMINCK and SCHLEGEL, 1842).

Rogadius asper JORDAN and RICHARDSON, 1908, p. 630, fig. 1, Swatow, China (description).——JORDAN, TANAKA and SNYDER, 1913, p. 286, fig. 236 (synonymy; distribution).——FUJITA and WAKIYA, 1915, p. 12, Kisyû (listed).——IZUKA and MATSUURA, 1920, p. 123, Kagoshima (listed).——JORDAN and HUBBS, 1925, p. 288, Kagoshima (listed).——UI, 1929, p. 235, Kisyû (notes).——TANAKA, 1931, p. 37 (listed).——FOWLER, 1931, p. 306, Hong Kong (listed).——KURODA, 1931, p. 119, Shizuura, Suruga Bay (listed).——NAKAMURA, 1934, p. 19, Toyama Prefecture (notes).——OKADA and MATSUBARA, 1938, p. 333 (key; distribution).——KAMOHARA, 1938, p. 51, Prov, Tosa (notes).——MAKO, 1949, p. 133, East China Sea; Yellow Sea (listed).——KATAYAMA, 1950, p. 9, East China Sea (listed).——KURODA, 1951, p. 381, Suruga Bay (distributional note).——KAMOHARA, 1952, p. 70, Prov. Tosa (listed).

Meterial described.——No. 1404 (MATSUBARA's Fish Collection), 146.5 mm. in standard length (178 0 mm. in total length, off Owashi, Kumano-nada, December 6, 1935.——Nos. 14590, 14593, and 14594, 53.0-130.5 mm. (71.0-157.0 mm.), Nobeoka, Miyazaki Pref., November 10, 1950.——Nos. 15235-15243, 68.0-140.5 mm. (83.0-168.0 mm.), off Owashi, January 10, 1951.——Nos. 15519-15521, 15523-15538, and 15559-15564, 86.0-156.0 mm. (106.0-187.0 mm.), off Urado, Kôchi Pref., February 20, 1951.——No. 16809, 129.0 mm. (157.0 mm.), off Ôsaka, October, 1950.

Description.—The counts and measurements (followed by averages in parentheses) of these 39 specimens vary extensively as follows:

Dorsal spines 1, 8 (1, 8); dorsal soft rays 11 (11); anal fin rays 11 (11); pectoral fin rays 21 to 33 (21.84). Gill-rakers on first arch 1+6 or 7=7 or 8 (7.29). Pored scales in lateral line 47 to 55 (51.23). Pyloric coeca 7 (7).

Measurement divided into standard length: greatest body depth 6.14 to 8.20 (7.02); greatest body width 4.30 to 5.70 (4.75); head length 2.36 to 2.71 (2.56); depth of caudal peduncle 16.70 to 22.00 (18.89). Measurement divided into head length: snout length 3.10 to 3.58 (3.39); eye diameter 3.30 to 4.60 (3.73); interorbital width 15.60 to 27.10 (18.90); upper jaw length 2.26 to 3.23 (2.52); pectoral fin length 1.59 to 3.45 (2.22); pelvic fin length 1.31 to 1.66 (1.50); dorsal first spine 5.40 to 12.25 (7.85); dorsal second spine 2.62 to 4.13 (3.33); dorsal first soft ray 2.73 to 4.90 (3.54); dorsal second soft ray 2.21 to 3.50 (2.61).

Remarks.—Upon a careful examination of the specimens of *Rogadius asper* (CUVIER and VALENCIENNES) and a review of the descriptions of the East Indian species, *Platycephalus pristiger* CUVIER and VALENCIENNES (=*Rogadius pristiger*) by various authorities, we have failed to find sufficient differences that will enable us to separate these 2 species, althougth the interorbital space appears to be more or less narrower in Japanese species than in the other. The interorbital space is about one-fifth as wide as the eye diameter in the Japanese species, whereas it is one-fourth (GÜNTHER, 1860, p. 189) to a half (FOWLER, 1928, p. 302) in the latter.

Genus *Suggrundus* WHITLEY

Insidiator JORDAN and SNYDER, 1900, p. 368 (type by original designation *Platycephalus rudis* GÜNTHER =*Platycephalus meerdervoortii* BLEEKER).

Suggrundus WHITLEY, 1930, p. 26 (substitute for *Insidiator* JORDAN and SNYDER, preoccupied, genotype designated as *Platycephalus rudis* GÜNTHER).

According to WHITLEY (1930, p. 26) the genus *Insidiator* JORDAN and SNYDER, 1900 is perhaps preoccupied by *Insidiator* AMYOT, 1846, a non-binominal genus of insects, but is certainly preoccupied by *Insidiator* OKEN, 1842, a genus of fishes equivalent to *Epibulus* CUVIER, 1816, and he renamed *Suggrundus* with *Platycephalus rudis* GÜNTHER as genotype.

Ocular cirrus absent; iris lappet bilobed, but never cirrose (Fig. 2, G). Anterior nostril fringed with a dermal flap posteriorly. Interopercular flap tongue-like (Fig. 3, E). Scales moderate in size; pored scales in lateral line 50 to 60, and they agree exactly with transverse rows of scales running obliquely backward and downward, but much fewer than those running obliquely forward and downward (Table 1); pored scales nearly quadrate, spined anteriorly, the perforating duct robust, communicated with exterior through ends of 2 thick tubes (Fig. 4, D).

Teeth either villiform or granular, in broad band on jaws, vomer, palatines and pharyngeals; vomerine teeth in 2 parallel longitudinal bands (Figs. 7,F; 8,F; 9,G; 10,F; 11,E; 12,J). Gill-rakers on first arch 1+7 to 10=8 to 11 (Table 2); discal tubercles on the arch moderately large, irregularly in 2 or 3 series, and thickly invest interspaces between gill-rakers (Fig. 13, I). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this

bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; upper surface of preorbital and median longitudinal keel on preorbital and anteriormost 2 suborbital bones finely granulated though less than in *Rogadius*; lower anterior margin of preorbital bone indefinitely serrated; first suborbital bone broadly overlapping above anterior part of second suborbital bone; hindmost branch of suborbital sensory canal bridged over on posterior part of preorbital bone (Figs. 15, D; 16, A). Hyomandibular process long, metapterygoid lamina distinct; interosseous space between them not wholly covered with posterior part of metapterygoid bone; posterior half of metapterygoid bone turned outward. Preopercular spines 3, all distinct, the uppermost one much larger than the second one; no antrorse spine; a sharp spine at base of uppermost preopercular spine. 2 opercular spines, each preceded by a stout keel. Preopercular sensory canal slender; branches of the canal long; upper insertion of this organ ramified into 4 distinct tubes; the organ lacking opening between ramified insertion and uppermost branch of the organ (Figs. 17, D; 18, D; 20, E). Glossohyal quadrangular, the posterior margin deeply concave. Urohyal widest at about posterior one-third of the bone and the posterior margin widely concave; urohyal shallowly invested in muscle of isthmus, and lower aspect of the bone shallowly concave between lateral keels (Fig. 22, G). Cranium well granulated and spined; postorbital part of cranium much wider than long, and much shorter than twice diameter of orbit; supraorbital rim of frontal bone elevated, armed with a series of spinous ridge; horny process from posterior margin of opisthotic bone well developed, extending posteriorly far beyond posterior end of parietal; ventral process of basisphenoid well developed, meeting parasphenoid (Fig. 24, E). Upper lamina of clavicle covers anterior half of coracoids (Fig. 26, D). Postpelvic process simple, bluntly pointed; postpelvic and subpelvic keels simple, with roundish outer margin; suprapelvic keel forming an obtuse angle at upper anterior extremity (Fig. 28, B).

Remarks.—The present genus is fundamentally different from the genera *Onigocia* and *Rogadius* in the side of head bicarinate and in the horny process from posterior margin of the opisthotic bone is well developed, extending beyond posterior extremity of the parietal bone. The genus *Sorsogona* (Herre, 1934b, p. 67) can hardly be distinguished from the present genus except for having no interopercular flap. But the validity of the genus *Suggrundus*, as separable from other genera of the Inegociinae, seems to be sufficiently confirmed by various features, as indicated in the analytical key.

Suggrundus meerdervoorti (Bleeker)

Platycephalus meerdervoortii Bleeker, 1860, p. 80, pl. 1, fig 3, Nagasaki; Yedo (origir al description). ——Bleeker, 1879b, p. 12, Nagasaki; Yedo (description).

Platycephalus rudis Günther, 1880, p. 66, pl. 29, fig. B, Yokohama (original description).——Steindachner and Döderlein, 1887, p. 260, Tokyo (diagnosis).

Insidiator rudis Jordan and Snyder, 1900, p. 363, Tokyo (listed). ——Smith and Pope, 1906, p. 486,

Kôchi, Shikoku (listed).

Thysanophrys meerdervoortii JORDAN and RICHARDSON, 1908a, p. 635, Wakanoura; Shimizu (description).——SNYDER, 1912a, p. 434, Tokyo; Kagoshima; Shimizu markets (listed).——JORDAN, TANAKA and SNYDER, 1913, p. 286 (synonymy; distribution).——IZUKA and MATSUURA, 1920, p. 123, Misaki (listed).——UI, 1929, p. 234, Kisyû (diagnosis).——WU, 1931, p. 33, Foochow, China (description).——YANAI, 1950, p. 22, Sanin District, southwestern part of Honsyû (listed).——CHEN, 1951, p. 157, Taiwan (diagnosis).

Thysanophrys (*meerdervoortii*) FRANZ, 1910, p. 78 (listed).

Insidiator meerdervoorti JORDAN and HUBBS, 1925, p. 287, Wakanoura; Toba, Kobe and Yokohama markets; Mikawa Bay; Toyama; Miyazu; Noo, Niigata Pref. (diagnosis).——OKADA, UCHIDA and MATSUBARA, 1935, p. 221, pl. 128, fig. 2, Tokyo market (description; distribution).——INOUYE and SHIMIZU, 1937, pp. 12, 16 and 22, off Kariya-ura, off Sano-ura and off Murotsu-ura, all Inland Sea of Japan (listed).

Thysanophrys meerdevoortii SCHMIDT and LINDBERG, 1930, p. 1146, Tsuruga (diagnosis).——SCHMIDT, 1931b, p. 117, Nagasaki (listed).

Suggrundus meerdervoortii WHITLEY, 1930, p. 16 (nomenclature).——OKADA and MATSUBARA, 1938, p. 334 (key; distribution).

Thysanophrys meerdervoorti TANAKA, 1931, p. 37 (listed).——KAMOHARA, 1938, p. 51, Prov. Tosa (notes).——KATAYAMA, 1940, p. 19, Toyama Bay (listed).——KURODA, 1947, p. 30, off Senbon and off Shige, Suruga Bay (notes).——KURODA, 1951, p. 182, Suruga Bay (distributional note).——KAMOHARA, 1952, p. 70, Prov. Tosa (notes).

Thysanophrys (*Insidiator*) *meerdervoortii* SCHMIDT, 1931a, p. 117, Nagasaki; Fuzan, Korea (diagnosis).

Suggrundus meerdervoorti MAKO, 1949, p. 133, East China Sea; Yellow Sea (listed).——KATAYAMA, 1950, p. 9, East China Sea; Yellow Sea (listed).——MATSUBARA, OKADA, SUZUKI and HASHIMOTO, 1951, p. 37, Sakade and Owashi, Mie Pref. (listed).——HONMA, 1952, p. 223, Niigata Pref. (listed).

Material described.——Nos. 1406-1407 (MATSUBARA'S Fish Collection), 110.0-160.0mm. in standard length (131.0-194.0 mm. in total length), off Owashi, Kumano-nada, January 4, 1936.——No. 4030, 133.0 mm. (159.0 mm.), Chôshi, Chiba Pref., March, 1937.——No. 4595, 140.0 mm. (170.0 mm.), off Owashi, January, 1937.——No. 7673, 157.5 mm. (186.0 mm.), Chôshi, December 14, 1939.——Nos. 8898-8899, 159.0-160.0 mm. (188.0-189.0 mm.), Kanaiwa, Ishikawa Pref., October 26, 1942.——No. 8967, 212.0 mm. (247.0 mm.), Ogi, Ishikawa Pref., October 28, 1942.——Nos. 10124, and 10126-10127, 117.0-131.0 mm. (136.5-155.0 mm.) off Maisaka, Shizuoka Pref., February, 1948.——No. 10261, 128.0 mm. (155.0 mm.), Hamada, Shimane Pref., May 13, 1948.——Nos. 11300-11301, 11303-11307, and 11309-11312, 84.0-172.0 mm. (102.5-203.0 mm.), Tsuiyama, Hyôgo Pref., April 4, 1949.——Nos. 11498-11506, 133.0-173.0 mm. (157.0-204.0 mm.), Maizuru, Kyoto Pref., April 28, 1949.——No. 12083, 146.0 mm. (175.0 mm.) Niigata. January, 1950.——No. 12171, 185.0 mm. (213.0 mm.), East China Sea, October 20, 1949.——Nos. 12257, 12266-12270, 12272-12275, 12357, 12365-13368, and 12437, 157.0-205.0 mm. (186.0-240.0 mm.), East China Sea, January, 1950.——Nos. 14241-14252, 140.0-188.0 mm. (166.5-218.5 mm), East China Sea, October 10, 1950.——No. 14477, 137.0 mm. (163.0 mm.), Onomichi, Hiroshima Pref., November 12, 1950.——Nos. 14571-14579, 14581-14583, and 14585-14587, 81.0-178.0 mm. (99.0-206.0 mm.), Nobeoka, Miyazaki Pref., Nobemver 10, 1950.——Nos. 14723-14725, 145.0-184.0 mm. (173.5-221.0 mm.), East China Sea, November 6, 1950.——Nos. 14948-14953, 101.5-189.0 mm. (125.5-224.0 mm), date unknown.——No. 15015, 207.0 mm. (242.0 mm.), off Owashi, January 15, 1951.——Nos. 15250-15283, 60.0-184.0 mm. (97.0-209.0 mm.), off Owashi, January 20, 1950.——Nos. 16808 and 16853, 81.5-121.0 mm. (97.0-139.0 mm.), off Ôsaka, October, 1950.——No. 17064, 162.0 mm. (191.0 mm.), Taiza, Kyoto Pref., December 4, 1951.

Description.—The counts and measurements (followed by averages in parentheses) of these 126 specimens vary rather extensively as given follows:

Dorsal spines 1, 7 to 8 (1, 7.80); dorsal soft rays 11 (11); anal fin rays 11 (11); pectoral fin rays 19 to 22 (20.89). Gill-rakers on first arch 1+7 to 10=8 to 11 (9.01). Pored scales in lateral line 51 to 56 (52.79). Pyloric coeca 6 (6). Measurement divided into standard length: greatest body depth 5.82 to 9.62 (7.47); greatest body width 4.02 to 5.66 (4.85); head length 2.72 to 3.10 (2.90); depth of caudal peduncle 17.30 to 22.30 (19.40). Measurement divided into head length: snout length 3.11 to 3.83 (3.41); eye diameter 3.64 to 4.96 (4.19); interorbital width 10.70 to 16.20 (12.85); upper jaw length 2.36 to 3.20 (2.75); pectoral fin length 1.23 to 1.60 (1.41); dorsal first spine 5.35 to 13.80 (8.05); dorsal second spine 2.18 to 3.13 (2.70); dorsal first soft ray 2.44 to 3.68 (3.02); dorsal second soft ray 1.95 to 3.03 (2.29).

Remarks.—*Platycephalus rudis* GÜNTHER is apparently identical with the present species, as suggested, as early as 1908, by JORDAN and RICHARDSON (1908a. p. 635).

Genus *Inegocia* JORDAN and THOMPSON

Inegocia JORDAN and THOMPSON, 1913, p. 70 (type by original designation *Platycephalus japonicus* TILESIUS).

Ocular cirrus absent; iris lappet never bilobed, but cirrose, the cirri well developed, dichotomous, some of them nearly reaching opposite margin of pupil (Fig. 2, E•F). Anterior nostril with a dermal flap posteriorly. Interopercular flap well developed (Fig. 3, B•D). Scales moderately large; pored scales in lateral line 50 to 55, much fewer than transverse rows of scales running obliquely forward and downward (Table 1). Scales in lateral line rectangular in shape, spined anteriorly; the perforating duct slender, communicated with exterior usually through ends of 2 tubes (Fig. 5, E•F). Pectoral fin roundish in outline; dorsal second spine about as long as third spine.

Teeth either villiform or granular, in broad band on jaws, vomer, palatines and pharyngeals; vomerine teeth in 2 parallel longitudinal bands (Fig. 7, I•J; 8, I•J; 9, I•J; 10, H•I; 11, G•J; 12, C•F). Gill-rakers on first arch 1 + 5=6 (Table 2); discal tubercles on first gill-arch exceedingly large, uniserial and interpolated between gill-rakers (Fig. 13, D•E). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; preorbital and suborbital bones not granulated; a pungent spine on upper surface of anteriormost 2 suborbital bones, but absent on preorbital bone; lower anterior margin of preorbital bone entire; first suborbital bone broadly overlapping above anterior part of second suborbital bone (Fig. 15, G•H). Hyomandibular process long, metapterygoid lamina distinct, forming a large interosseous space between them, two-thirds of which covered with posterior part of metapterygoid bone; posterior half of metapterygoid bone turned outward. 2 or 3 preopercular spines, the uppermost one slightly longer than second one; the third one from the

upper, if present, rudimentary and scarcely visible without elimination of skin; no antrorse spine. 2 opercular spines, each preceded by a stout keel. Preopercular sensory canal slender, the branches long (Figs. 17, F•H; 19, I•H; 20, D). Glossohyal quadrangular, the posterior margin concave. Urohyal widest at posterior one-third of the bone, the posterior margin deeply concave; urohyal shallowly invested in muscle of isthmus, and lower aspect of the bone shallowly concave between lateral keels (Figs. 22, F•D; 23, C). Cranium never granulated, but armed with strong spines; postorbital region of cranium longer than wide, but much shorter than twice diameter of orbit; supraorbital rim of frontal bone elevated, armed with a series of spinous ridge; horny process from posterior margin of opisthotic bone well developed, extending posteriorly far beyond posterior end of parietal bone; ventral process of basisphenoid well developed, meeting parasphenoid (Fig. 25, A•C). Upper lamina of clavicle covers anterior half of coracoids (Fig. 26, F•H). Postpelvic process simple, bluntly pointed; postpelvic and subpelvic keels simple, with roundish outer margin; suprapelvic keel forming an obtuse angle at upper extremity (Fig. 28, C•E).

Remarks.—The present genus is intimaetly related to the *Suggrundus*, from which it differs in 1) cirri of the iris lappet are well developed and dichotomous, 2) discal tubercles on the first gill arch are enlarged and uniserial, 3) the preorbital and suborbital bones are not granulated, 4) preopercular spines are 2 or 3, the uppermost one slightly longer than the second one; the third one, if present, is rudimentary, 5) upper insertion of the preopercular sensory canal is not ramified into 4 tubes, and 6) the cranium is never granulated, postorbital region of the bone is longer than wide.

Key to the species of the genus *Inegocia*

1a. Dorsal soft rays and anal rays each 12. Scales deciduous and larger; pored scales in lateral line 51 to 55, and they exactly agree with transverse rows of scales running obliquely backward and downward, but much fewer than those running forward and downward (75 to 83); anterior 6 to 8 pored scales spined. Snout shorter, 3.2 to 3.6 in head length; eye larger, the diameter 4.0 to 4.8 in head length; dorsal first spine longer, 6.7 to 10.0 in head length. Interopercular flap longer than wide, caniniform, and acutely pointed (Fig. 3•B). Body grayish brown above, without dark spots; the back crossed with about 6 obscure and ill-defined bands of darker; dorsal spines each furnished with a row of small dark spots. Body usually smaller than 250 mm. ..... *Inegocia japonica*

1b. Dorsal soft rays and anal rays each 11. Scales adhesive; pored scales in lateral line 50 to 52, and much fewer than transverse rows of scales running obliquely either backward and downward (67 to 76) or forward and downward (98 to 101); anterior 1 to 3 pored scales spined. Snout longer, 2.9 to 3.1 in head length; eye smaller, the diameter 5.3 to 6.0 in head length; dorsal first spine shorter, 11.0 to 20.0 in head length. Interopercular flap tongue-like, rather broader than long, and bluntly pointed at the tip (Fig. 3•D). Body dark brown above, covered with darker spots; the back crossed with 5 to 7 well-defined bands of darker; posterior half to two-thirds of first dorsal fin dark brown. Body attains more than 500 mm. ..... *Inegocia guttata*

Inegocia japonica (Tilesius)

Platycephalus japonicus Tilesius, 1812, p. 59, pl. 59, fig. 1, Nagasaki (original description).——Cuvier and Valenciennes, 1829, p. 256 (description, after Tilesius). ——Richardson, 1846, p. 217, China seas (notes).——(pars) Temminck and Schlegel, 1843, p. 40, pl. 16, fig. 3, Nagasaki (diagnosis).——Bleeker, 1857, p. 78, Nagasaki (description).——Günther, 1860, p. 181, China; Japan (description). ——Günther, 1879, p. 55, Hong Kong (description).——Steindachner and Döderlein, 1887, p. 260, Tokyo (description). ——Smith and Pope, 1906, p. 486, Kochi; Kagoshima (notes). ——Boeseman, 1947, p. 49 (revision of *Platycephalus japonicus* of Temminck and Schlegel)

Thysanophrys japocicus Jordan and Richardson, 1908a, p. 636, fig. 3, Tokyo; Misaki; Tsuruga; Nagasaki; Wakanoura (description). —— Jordan and Richardson 1909, p. 194, Takao, Formosa (listed). ——Snyder, 1912a, p. 434, Tokyo, Misaki and Kagoshima markets (listed). ——Fujita and Wakiya, 1915, p. 12, Kisyû (listed). ——Izuka and Matsuura, 1920, p. 123, Enoura, Suruga Bay (listed).——Fowler, 1928, p. 300 (notes). ——Ui, 1929, p. 235, Kisyû (notes).——Fowler, 1931a, p. 350, Samoa (listed).——Fowler, 1931b, p. 306, Hong Kong (listed).——Schmidt, 1931b, p. 117, Obama, Fukui Pref. (notes). ——Tanaka, 1931, p. 37 (listed). ——Koike, 1936, p. 12, Fukui Pref. (listed). ——Kamohara, 1938, p. 51, Prov. Tosa, Shikoku (notes).——Kuroda, 1947, p. 30, Tago, Shige and Senbon, Suruga Bay (notes). ——Yanai, 1950, p. 22, Sanin District, south western part of Honsyû (listed). —— Kuroda, 1951, p. 382, Suruga Bay (distributional note). —— Kamohara, 1952, p. 70, Prov, Tosa (notes).

Inegocia japonica Jordan and Thompson, 1914, p. 278, fig. 51, Misaki (listed).——Jordan and Hubbs, 1925, p. 287, Wakanoura, Tokyo and Kobe markets; Kagoshima Bay; Misaki; Miyazu (listed).—— Mori, 1928, p. 71, Fusan (listed).——Mori and Uchida, 1934, p. 18, Fusan (listed).——Okada and Matsubara, 1938, p. 334 (key; distribution).——Suyehiro, 1942, p. 203, fig. 157 (anatomy of digestive system).——Katayama, 1950, p. 9, East China Sea; Yellow Sea (listed). ——Liang, 1951, p. 30, Taiwan (listed).——Matsubara, Okada, Susuki and Hashimoto, 1951, p. 37, Owashi, Kumano-nada (listed).——Mori, 1952, p. 160, Fusan (listed).

Thysanophrys (*Inegocia*) *japonicus* Schmidt, 1931a, p. 116, Nagasaki; Bôshiu (diagnosis).

Suggrundus japonicus Fowler, 1949, p. 109 (listed).

Thysanophrys japonica Chen, 1951, p. 157, Taiwan (diagnosis).

Material described.——No. 1143 (Matsubara's Fish Collection), 172.0 mm. in standard length (206.0 mm. in total length), off Maisaka, Shizuoka Pref. ——Nos. 1230, 1237–1238, and 1240, 141.0-166.0 mm. (169.0–192.0 mm.), off Owashi, Kumano-nada, December 6, 1935.——No. 13920, 153.0 mm. (184.0 mm.), off Owashi, September 20, 1950.——No. 14588, 163.5 mm. (191.5 mm.), off Saheki, Ôita Pref., October, 1950.——Nos. 14954–14955, 116.5–174.0 mm. (139.0-206.0 mm.), date unknown.——No. 14956, 129.0 mm. (151.0 mm.), off Nobeoka, Miyazaki Pref., October 10, 1950.——No. 15247, 210.0 mm. (247.0 mm.), off Owashi, January 10, 1951.——Nos. 15474-15482, and 15676, 160.0-307.5 mm. (192.5-241.5 mm.), off Urado, Kôchi Pref., February 25, 1951.

The present species appear to have been frequently confused with *Cociella crocodila* (Boeseman, 1947, pp. 49–50). The following description may serve for distinction of the species from it.

Description.—The counts and measurements (followed by averages in parentheses) of these 21 specimens run as follows:

Dorsal spines 1, 8 (1, 8); dorsal soft rays 12 (12); anal fin rays 12 (12); pectoral fin rays 19 to 21 (20.10). Gill-rakers on first arch $1+5=6$ (6). Pored scales in lateral line 49 to 54 (52.0). Pyloric coeca 7 (7). Measurement divided

into standard length: greatest body depth 5.23 to 8.60 (7.42); greatest body width 4.42 to 5.35 (5.04); head length 2.82 to 3.03 (2.94); depth of caudal peduncle 17.60 to 24.00 (22.70). Measurement divided into head length: snout length 3.19 to 3.59 (3.39); eye diameter 4.00 to 4.84 (4.45); interorbital width 12.70 to 16.00 (14.35); upper jaw length 2.50 to 2.84 (2.71); pectoral fin length 1.97 to 2.37 (2.17); pelvic fin length 1.26 to 1.47 (1.35); dorsal first spine 6.66 to 10.00 (8.00); dorsal second spine 2.19 to 2.75 (2.44); dorsal first soft ray 2.66 to 3.66 (2.95); dorsal second soft ray 2.17 to 2.66 (2.43).

Head broad and large, slightly more than twice as broad as high at base of uppermost preopercular spine and usually more or less longer than one-third the length of body. Top and sides of head moderately armed with spines and fine ridges; supercilliary ridge elevated, armed with about 6 to 11 posteriorly directed spines, all behind middle of eye; in front of each ridge a sharp posteriorly directed preocular spine present. A row of about 6 to 9 spines from posterior edge of orbit to origin of lateral line, the last 2 of them on scapular ridge. Parietoccipital region with a pair of low ridge, each armed with 2 to 4 spines. Infraorbital ridge armed with 3 sharp backward-directed spines, the anteriormost one below middle of eye, the middle one below hind edge of orbit, and the last one, which very frequently absent, just in front of uppermost preopercular spine; central part of preorbital bone unarmed. 2 very small nasal spines on middle of snout. Lower anterior margin of preorbital bone entirely smooth. Preopercular spines 3, the uppermost one larger than second one, but never especially enlarged; the lowermost one rudimentary. Opercular spines 2, each preceded by a stout unarmed keel.

Snout much longer than eye. Eye about 3 times as long as interorbital width; iris lappet never bilobed, but cirrose; the cirri well developed, dichotomous, and sharply pointed, some of them reaching opposite margin of pupil (Fig. 2, F); interorbital region moderately concave. Nostrils 2 on each side, opening on top of low nasal tube; posterior half of anterior nostril fringed with a long dermal flap; posterior nostril entire. Mouth large, maxillary nearly reaches to below front edge of pupil; rear margin of maxillary deeply concave, and upper half of the bone hidden under suborbital bones. Lower jaw projecting beyond the upper in closed mouth. Tongue very broad, fan-like in shape, the anterior margin broadly but shallowly concave, without a median convexity. Teeth villiform or granular, in broad band on jaws, vomer, palatines and pharyngeals. Interopercular flap longer than wide, caniniform and acutely pointed (Fig. 3, B).

Gill-rakers long, stout and rounded at tips, their inner surface thickly covered with spinules. Discal tubercles on first arch exceedingly enlarged, flattish, thickly covered with spinules; the tubercles uniserial and interpolated between gill-rakers (Fig. 13- E).

Origin of dorsal fin advances before base of pelvic fin by a distance equal to

two-thirds diameter of eye; spinous dorsal much higher but shorter than soft dorsal; dorsal second or fourth spine but little shorter than third one. Anal begins below base of second or third dorsal soft rays, the base a little longer than that of soft dorsal fin. Caudal rounded. Pectoral fin broad, the lower 6 or 7 rays simple, the fin reaches below base of sixth or seventh dorsal spine. Pelvic fin much longer than pectoral fin, reaching origin of anal fin or a little beyond.

Scales deciduous, moderately large; pored scales in lateral line agree exactly with transverse rows of scales running obliquely backward and downward, but much fewer than those running forward and downward (Table 1). Scales in lateral line roughly rectangular, the anterior 6 to 8 scales spined; perforating duct of lateral line scales slender, about 3 times as long as broad, and communicated with exterior through ends of 2 slender tubes (Fig. 5, E). Postorbital region of head, occipital region and operculum scaly, but other parts of head naked; fins naked except for scaled basal part of caudal.

Color in formalin grayish brown above and sides, whitish below; the back crossed with about 6 obscure, ill-defined bands of darker, but without dark spots; head grayish brown, obscurely and finely specked with darker; side of head below suborbital keel crossed transversely by alternating broad and narrow bars of darker; lower lip also crossed by similar bars. Dorsal and pectoral fins with membranes pale, but their rays each furnished with a lengthwise series of small dark spots. Caudal with rays pale, the membranes being spotted with dark brown; the anterior spots roundish, forming indistinct rows; the posterior spots larger and elongate antero-posteriorly.

Remarks.—Some authors appear to have confound this fish with *Cociella crocodila* (Tilesius), but they may be clearly distinguished from each other in characteristics contrasted in items 12a and 12b of the analytical key and many other features.

Inegocia guttata (Cuvier and Valenciennes)
Wani-gochi (new Japanese name)
Pl. 1

Platycephalus guttata Cuvier and Valenciennes, 1829, p. 244, Japan (original description).——Temminck and Schlegel, 1843, p. 39, pl. 15, fig. 2, Bay of Nagasaki (diagnosis).——Richardson, 1846, p. 217, Canton (notes).——Günther, 1860, p. 183 (notes).——? Ishikawa and Matsuura, 1897, p. 48, Tokyo market (listed). ——Boeseman, 1947, p. 49 (revision of *Platycephalus guttatus* of Temminck and Schlegel).

Material described. —— No. 14342 (Matsubara's Fish Collection), 277.0 mm. in standard length (334.0 mm. in total length, off Maizuru, Kyoto Pref., September 16, 1950. —— No. 14721, 325.5 mm. (380.0 mm.), East China Sea, November 5. 1950.——No. 14589, 284.0 mm. (318.5 mm.), off Nobeoka, Miyazaki Pref., October 10, 1950.——Nos. 15573-15575, 293.0-458.0 mm. (343.0-428.0 mm.), off Urado, Kôchi Pref., February 20. 1951.

Jordan and Richardson (1908a, p. 638) synonymized this fish with *Platycephalus crocodilus* of Tilesius, and no one has ever since been entertained doubt for

their action. This species, however, is sharply distinguished from it, not only in the generic features indicated in the analytical key, but also in many other points.

Description.—Of this rare species we have had available only 6 specimens collected from Maizuru, Nobeoka, Urado and East China Sea. Their counts and measurements (followed by averages in parentheses) run as follows:

Dorsal spines 1, 7 or 8 (1, 7.66); dorsal soft rays 11 (11); anal fin rays 11 (11); pectoral fin rays 21 or 22 (21.33). Gill-rakers on first arch $1+5=6$ (6). Pored scales in lateral line 49 or 50 (49.40). Pyloric coeca 7 (7). Measurement divided into standard length: greatest body depth 7.25 to 9.55 (8.16); greatest body width 3.98 to 5.06 (4.70); head length 2.53 to 2.93 (2.76); depth of caudal peduncle 18.45 to 20.90 (20.05). Measurement divided into head length: snout length 2.87 to 3.13 (3.00); eye diameter 5.34 to 6.03 (5.83); interorbital width 10.58 to 13.70 (11.67); upper jaw length 2.62 to 2.87 (2.71); pectoral fin length 2.14 to 2.57 (2.39); pelvic fin length 1.30 to 1.65 (1.48); dorsal first spine 11.10 to 19.80 (13.95); dorsal second spine 2.50 to 3.18 (2.75); dorsal first soft ray 2.82 to 3.56 (3.13); dorsal second soft ray 2.70 to 3.37 (2.94).

Head broad and large, more than twice as broad as high at base of uppermost preopercular spine and always longer than one-third the length of body without caudal. Top and sides of head roughened with spines and sculptured with fine smooth ridges; supercilliary ridges elevated, each armed with about 3 to 5 stout backward-directed spines on posterior one-third of eye; a sharp and stout backward-directed preocular spine in front of eye; a row of 5 similar spines from posterior part of eye to origin of lateral line, the last 2 of them on scapular ridge. Parietoccipital region with a pair of low ridge, each armed with a single spine at the middle part. Infraorbital ridge armed with 3 stout backward-directed spines, the anteriormost one below front edge of pupil, the middle one below hind edge of orbit, and the last one, which is very small, immediately in front of uppermost preopercular spine; central part of preorbital bone unarmed. A pair of small nasal spine on middle part of snout. Lower anterior margin of preorbital bone entirely smooth. Preopercular spines usually 2, the upper one larger than the lower, but never especially enlarged. Opercular spines 2, pungent, each preceded by a smooth lowkeel.

Snout nearly twice as long as diameter of eye. Eye moderately large, about twice as long as interorbital width; iris lappet never bilobed, but cirrose, the cirri well developed, dichotomous, and rounded at their tips, some of them nearly reaching opposite margin of pupil (Fig. 2, E); interorbital region moderately and widely concave. Nostrils, 2 on each side, opening on top of low nasal tube, anterior nostril fringed with a falciform dermal flap posteriorly; posterior nostril with entire rim. Maxillary scarcely reaching front edge of orbit, the upper margin hidden under suborbital bones. Lower jaw projecting far beyond the upper in closed mouth. Tongue very broad, fan-like in shape, the anterior margin broadly and shallowly concave,

with a median inconspicuous convexity. Teeth either villiform or granular, in broad band on jaws, vomer, palatines and pharyngeals; inner posterior lobe of lower pharyngeal patch of teeth enlarged opposite is the case with other Japanese flatheads (Fig. 11, J). Interopercular flap very large, tongue-like in shape, rather broader than long, and bluntly pointed at the tip (Fig. 3, D).

Gill-rakers on first arch long, stout and blunt at their tips, their inner surface thickly covered with sharp spinules. Discal tubercles on the arch exceedingly enlarged, flattish, thickly armed with sharp spinules; the tubercles generally uniserial and interpolated between gill-rakers (Fig. 13, D).

Dorsal fin inserted before origin of pelvic fin by a distance equal to about one-fourth diameter of eye; spinous dorsal much higher but shorter than soft dorsal, third dorsal spine the highest, slightly higher than either second or fourth spine. Anal fin begins below base of third dorsal soft ray, the base but little longer than that of second dorsal fin. Caudal fin rounded. Pectoral fin broad, rounded, the lower 9 rays simple and more or less thickened; it reaches below base of dorsal sixth spine or a little beyond. Pelvic fin much longer than pectoral fin, reaching origin of anal fin or a little beyond.

Scales adhesive, rather small; pored scales in lateral line much fewer than transverse rows of scales running obliquely either backward and downward or forward and downward (Table 1). Pored scales in lateral line rectangular in shape, the anterior 1 to 3 scales spined; perforating duct of the scales slender, more than 3 times as long as broad, and communicated with exterior through ends of 2 slender tubes except for about first 12 scales, in which the upper tube absent or rudimentary, if present (Fig. 5, F). Postorbital region of head, occipital region and operculum scaly, but other parts of head naked; fins naked except for scaled basal part or caudal fin.

Color in formalin dark brown above, whitish below, the back and sides of body inclusive of head specked with darker and crossed usually with 8 well defined broad bands of darker, the first band on top of head between eyes and extends to suborbital region across eye, the second and third one on occiput, the fourth one below insertion of first dorsal, the fifth one below posterior part of first dorsal, the sixth one below middle of second dorsal, the seventh one below posterior part of second dorsal, and the last one on posterior part of caudal peduncle; in larger specimens an obscure band below middle of first and similar one below origin of second dorsal. Premaxillary and lower lip crossed with bars of darker; maxillary with a dark longitudinal bars along median line. Posterior half to two-thirds of first dorsal dark brown; second dorsal with large dark spots, forming 6 or 7 dark cross bars. Caudal crossed with about 4 broad dark bars, which here and there breaking into recognizable roundish dark spots; the hindmost 2 bars nearly fused together on posterior one-third of the fin. Distal half of anal more or less dusky. Pectoral rays with spots of darker, forming obscure and irregular cross bars. Pelvic fin

with characteristic large dark spots.

Remarks.—The specimens here dealt with agree well with the *Platycephalus guttatus* in description given by CUVIER and VALENCIENNES (1829, p. 244) and also by TEMMINCK and SCHLEGEL (1843, p. 39, pl. 15, fig. 2) except for having 11 soft rays, instead of being 12 in the latter, in both second dorsal and anal fins. BOESEMAN (1947, p. 49), however, reexamined the specimens figured and described by TEMMINCK and SCHLEGEL and ascertained it was indeed 11 instead of 12.

This species is sharply distinguished from *Inegocia japonica*, not only in features indicated in the analytical key, but also in the following features: 1) in the perforating duct of about first 12 lateral line scales tha upper tube is absent or rudimentary, if present, instead of being well developed in the latter (Fig. 5, E-F), 2) hindmost branch of the suborbital sensory organ from the preorbitrl bone is bridged over, instead of not being bridged over in the latter, on posterior part of the bone (Figs. 15, G-H; 16, A-C), 3) preopercular sensory canal not opens, versus widely opens in the latter, between the first branch and upper insertion of the organ, and upper insertion of the organ ramified into 2 parts instead of being single in the latter (Figs. 17, F-H; 19, H-I; 20, D), and 4) inner posterior lobe of the lower pharyngeal patch of teeth is enlarged, opposite being the case with the latter (Fig. 11, G-J).

In general physiognomy and color pattern the present species closely resembles *Insidiator parilis* of MCCULLOCH (1914, p. 151, fig. 14, pl. 31, fig. 2) found in Port Darwin and the Gulf of Carpentaria, but differs from it at least in having much smaller eye (eye diameter is about 2.0 in snout length, whereas it is 1.6 to 1.7 in the latter) and much wider interorbital space (the width is about 2.0 in eye diameter, but it is 3.1 to 4.5 in the latter).

Genus *Cociella* WHITLEY

Cocius JORDAN and HUBBS, 1925, p. 286 (type by original designation *Platycephalus crocodilus* TILESIUS). *Cociella* WHITLEY, 1940, p. 243 (substitute for *Cocius* JORDAN and HUBBS, preoccupied).

According to WHITLEY the genus *Cocius* JORDAN and HUBBS is preoccupied, and he renamed *Cociella* substitute for it.

Ocular cirrus absent; iris lappet simple, semicircular, neither bilobed nor cirrose (Fig. 2, C). Anterior nostril with a dermal flap posteriorly. Interopercular flap absent (Fig. 3, J). Scales small; pored scales in lateral line 50 to 55, and they mucn fewer than transverse rows of scales running obliquely either backward and downward or forward and downward (Table 1); pored scales rectangular in shape, the first 3 or 4 scales spined; perforating duct of the scales slender, communicated with exterior through end of a single slender tube (Fig. 5, H).

Teeth either villiform or granular, in broad band on jaws, vomer, palatines and pharyngeals; vomerine teeth in 2 parallel longitudinal bands (Figs. 7, H; 8, H; 9, H; 10, G 11, F; 12, G). Gill-rakers on first arch 1+3 to 7=4 to 8 (Table 2); discal tubercles

on the arch large, irregularly in 2 or 3 series, and thickly invest interspaces between gill-rakers (Fig. 13, J). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; preorbital and suborbital bones not granulated, but a pungent spine on central part of both preorbital and first suborbital bones and 1 or rarely 2 similar ones on second suborbital bone; lower anterior margin of preorbital bone smooth; first suborbital bone overlapping above anterior part of second suborbital bone; hindmost branch of suborbital sensory organ from preorbital bone not bridged over on posterior part of the bone (Figs. 15, F; 16, C). Hyomandibular process and metapterygoid lamina long, forming a large interosseous space between them, about two-thirds of which covered with posterior part of metapterygoid bone; posterior half of metapterygoid bone turned outward. 2 or 3 preopercular spines, the uppermost one especially prolonged into a bayonet-shape; the third one from the upper, if present, rudimentary; no antrorse preopercular spine; an accessory spine at base of uppermost preopecular spine sharp. 2 opercular spines, each preceded by a stout smooth keel. Preopercular sensory canal slender, not opens between the first branch and upper insertion of the organ; upper insertion of the organ simple; branches of the organ very slender (Figs. 17, G; 19, G; 20, C). Glossohyal quadrangular, the posterior margin shallowly concave. Urohyal widest at about posterior one-third of thd bone, the posterior margin deeply concave; urohyal shallowly invested in muscle of isthmus, and lower aspect of the bone shallowly concave between lateral keels of the bone (Fig. 22, E). Cranium not granulated, but armed with spines; postorbital region of cranium longer than wide, but shorter than twice diameter of orbit; posterior part of supraorbital rim of frontal bone elevated, armed with a series of spinous ridge; horny process from posterior margin of opisthotic bone well developed, extending posteriorly beyond rear end of parietal bone; ventral process of basisphenoid well developed, meeting parasphenoid (Fig. 25, B). Upper lamina of clavicle covers anterior half of coracoids (Fig. 26, G). Postpelvic process simple, bluntly pointed; postpelvic and subpelvic keels simple, with roundish outer margin; suprapelvic keel forming an obtuse angle at upper anterior extremity (Fig. 28, D).

Remarks.—The present genus is closely related to the *Inegocia*, from which it differs in 1) the interopercular flap is absent (Fig. 3, J), 2) the iris lappet is not cirrose (Fig. 2, C), 3) the perforating duct of lateral line scales is communicated with the exterior through end of a single slender tube (Fig. 5, H), 4) the uppermost preopercular spine is prolonged into a bayonet-shape, and it is much longer than the second one from the upper, 5) discal tubercles on the first gill-arch are placed irregularly in 2 or 3 series, and thickly invest interspaces between gill-rakers (Fig. 13, J), and 6) upper surface of the preorbital bone is armed with a pungent spine at the central part of it.

Cociella crocodila (Tilesius)

Platycephalus crocodilus Tilesius, 1812, pl. 59, fig. 2, Nagasaki (original description).——Cuvier and Valenciennes, 1829, p. 256 (description, after Tilesius).——Jordan and Snyder, 1900, p. 368, Tokyo (listed). ——Barnard, 1927, p. 933, Natal; Zululand coast (description; discussion). ——Abe, 1939, p. 576, Palao Islands (listed).——Smith, 1949, p. 378, southern Africa (diagnosis).

Platycephalus punctatus Cuvier and Valenciennes, 1829, p. 243 (Hindustan, Voy. Peron (original description). ——Günther, 1860, p. 180, coast of Trinbomalle; Sea of Batavia; Vanicolo Islands (description).——Bleeker, 1861, p. 32, Singapore (description?).——Bleeker, 1879a, p. 13, Pinang; Singapore (description?).——Günther, 1880, p. 66, Inland Sea of Japan (description).——Day, 1878–1888, p. 277, pl. 60, fig. 3, Indian seas (description).——Nyström, 1887, p. 259, Tokyo (description). ——Steindachner and Döderlein, 1887, p. 259, Tokyo (diagnosis). ——Day, 1889, p. 239, seas of Indian to Malay Archtipelago (description).——Sauvage, 1891, p. 307, pl. 36, figs. 5 and 5a, Madagascar (description).——Ishikawa and Matsuura, 1897, p. 48, Enoura, Suruga Bay (listed).——Smith and Pope, 1906, p. 486, Yamagawa (listed). ——Jordan and Seale, 1907, p. 38, Cavite, Philippine Islands (diagnosis).——Whitley, 1928, p. 12, Santa Cruz Archipelago, Melanesia (listed).——Suvatti, 1936, p. 676, Gulf of Siam, Sriracha (listed).

Patycephalus inermis (not *Silurus inermis* Houttuyn, 1878) Jordan and Evermann, 1903, p. 361, Keerun, Formosa (notes).

Platycephalus crocodilus Jordan and Richardson, 1908a, p. 638, fig. 4, Tokyo; Hiroshima; Nagasaki; Wakanoura (synonymy; description).——Franz, 1910. p. 78, Aburatsubo. Misaki; Fukuura (notes). ——Snyder, 1912a, p. 434, Kagoshima markets (listed).——Snyder, 1912b, p. 512, Okinawa, Riu-kiu Island (listed).——Jordan and Metz, 1913, p. 54, fig. 49, Fusan, Korea (listed).——Jordan, Tanaka and Snyder, 1913, p. 286, fig. 235 (distribution). ——Izuka and Matsuura, 1920, p. 123, Tokyo market (listed). ——Ichijima, 1927, p. 8, Toyama Pref. (listed). ——Fowler, 1928, p. 300 (description, after Bleeker).——Ui, 1929, p. 234, Kisyû (diagnosis).——Schmidt, 1930, p. 11, Kominato and Daikuma, Amami-ôshima (notes; distribution). ——Fowler, 1931a, p. 350 (synonymy).——Tanaka, 1931, p. 37 (listed). ——Wu, 1931, p, 34, Foochow, China (description). ——Kuroda, 1931, p. 119, Shizuura, Suruga Bay (note). ——Nakamura, 1934, p. 19, Toyama Bay (notes). ——Fowler, 1934, p. 431, New Hebrides (locality, after Whitley). ——Koike, 1936, p. 12, Fukui Pref. (listed).——Inouye and Shimizu, 1936, pp. 10, 11, 13 and 14, off Kariya and off Sano, Inland Sea of Japan (listed). ——Inouye and Shimizu, 1937, pp. 8, 12, and 22, Murotsu, Kariyaura, Sanoura and Murotsuura, Inland Sea of Japan (listed).——Kamohara, 1938, p. 51, Prov. Tosa (notes).——Katayama, 1940, p. 19, Toyama Bay (listed).——Kawakami, Nakaya and Matsui, 1949, p. 30, East China Sea; Yellow Sea (distribution).——Yanai, 1950, p. 22, Sanin District, south-western part of Honsyû (listed).——Kamohara, 1952, p. 70, Prov. Tosa (notes).

Inegocia crocodilus Jordan and Thompson, 1914, p. 279, Ôsaka (listed).

Cocius crocodilus Jordan and Hubbs, 1925, p. 287, Tokyo and Kobe markets; Toba; Mikawa Bay; Fukuoka; Miyazu; Noo, Niigata Pref. (listed).——Mori, 1928, p. 71, Fusan, Korea (listed).——Herre, 1933a, p. 5, Sandakan, British North Borneo (listed).——Herre, 1933b, p. 9 Dumaguete, Oriental Negros, Philippine Islands (listed). ——Mori and Uchida, 1934, p. 18, Fusan, Korea (listed). ——Herre, 1934a, p. 33, Hong Kong (listed).——Herre, 1934b, p. 66, Manila Bay, Atimonan, Cebu and Dumaguete, Philippine Islands (listed). ——Herre, 1937, p. 34, Singapore (listed). ——Roxas and Martin, 1937, p. 183, Philippine Islands (synonymy).——Okada and Matsubara, 1938, p. 334, (key; distribution).——Tortonese, 1939, p. 189, Yokohama (notes).——Herre, 1939, p. 340, Viper Island, Port Blain (synonymy). ——Herre, 1941, p. 374, Andaman Islands (distribution). ——Herre, 1945, p. 119, Tinghai; Dai Po, New Territory, Hong Kong; near Pakhoi, Kwangtung Province (listed). ——Mako, 1949, p. 133, East China Sea; Yellow Sea (listed).——Katayama, 1950, p. 6, East China Sea; Yellow Sea (listed).——Liang, 1951, p. 30, Taiwan (listed).——Matsubara, Okada, Susuki and Hashimoto, 1951, p. 37, Toba (listed).——Mori, 1952, p. 159, Fusan, Korea (notes).——Honma, 1952,

p. 223, Niigata Pref. (listed).
Thysanophrys (*Co·ius*) *crocodilus* SCHMIDT, 1931a, p. 117, Nagasaki (description).
Thysanophrys crocodylus BORODIN, 1932, p. 92, Singapore, Malay Straits (listed).
Coccius crocodilus FOWLER, 1938a, p. 204, Penang, Singapore (synonymy).
Coccius punctatus FOWLER, 1938a, p. 204, Singapore (synonymy).
Suggrundus crocodilus FOWLER, 1949, p. 108 (synonymy).

Material described.——No. 70 (MATSUBARA's Fish Collection), 312.0 mm. in standard length (362.0mm. in total length), off Owashi, Kumano-nada.——No. 168, 128.0mm. (150.0 mm.), Obama, Fukui Pref. ——No. 1408, 87.0 mm. (101.0 mm.), off Owashi, December 10, 1935. ——No. 2219, 141.0 mm. (166.0 mm.), off Owashi, January 5, 1936. ——No. 8717, 115.0 mm. (134.0 mm.), March 13, 1938.——No. 8846, 345.0 mm. (407.5 mm.), Kanaiwa, Ishikawa Pref., October 6, 1942.——No. 10278, 128.0 mm. (150.0 mm.), Obama, Fukui Pref., November, 1948. ——No. 11105, 285.0 mm (330.0 mm), Kanaiwa, Ishikawa Pref., April 3, 1949. ——Nos. 12100, and 12169–12170, 246.0–340.0 mm. (282.5–386.5 mm.), East China Sea, 1949. ——Nos. 12271, 12358–12364, and 12369, 242.0–362.5 mm. (281.0–417.0 mm.), East China Sea, January, 1950.——No. 14254, 380.0 mm. (428.0 mm.), East China Sea, October 10, 1950. ——Nos. 14475–14476, and 14478, 101.0–224.0 mm. (121.0–257.0 mm.), Onomichi, Hiroshima Pref., November 12, 1950.——No. 14489, 381.0 mm. (438.0 mm.), Maizuru, Kyoto Pref., October, 1950.——No. 14596, 300.0 mm. (349.0 mm.), Nobeoka, Miyazaki Pref., November 10, 1950.——Nos. 14710–14720, 231.2–327.0 mm. (263.0–366.0 mm.), East China Sea, November 6, 1950.——No. 14811, 257.0 mm. (303.5 mm.), Uozu, Toyama Pref., November 28, 1950.——No. 14896, 405.0 mm. (459.0 mm.), Nobeoka, December, 1950.——No. 15234, 218.0 mm. (253.0 mm.), Owashi, February 10, 1950.——Nos. 15571–15572, 240.0–297.0 mm. (281.0–343.0 mm.), Urado, Kochi Pref,, February 20, 1951.——Nos. 16007–16008, 337.0 –339.0 mm. (388.0–393.0 mm.), Maizuru, February 7, 1951.——No. 17074, 124.0 mm. (144.0 mm.), East China Sea, July, 1951.——No. 17075, 107.0 mm. (123.0 mm.), East China Sea, June, 1951.——No. 17076, 131.0 mm. (151.0 mm.), East China Sea, September 11, 1950. ——No. 17172, 123.5 mm. (146.5 mm.), Owashi, January 8, 1952.——No. 2777 (Collection of Prefectural University of Mie), 318.0 mm. (368.0 mm.), Tomioka, Kumamoto Pref., November, 1950.

Description.—The counts and measurements (followed by averages in parentheses) of these 49 specimens vary remarkably as follows:

Dorsal spines 1, 7 to 8 (1, 7.70); dorsal soft rays 11 (11); anal fin rays 11 (11); pectoral fin rays 19 to 21 (19.75). Gill-rakers on first arch 1+5 to 7=6 to 8 (6.80). Pored scales in lateral line 49 to 54 (50.80). Pyloric coeca 7 (7). Measurement divided into standard length: greatest body depth 8.24 to 11.40 (9.28); greatest body width 4.92 to 6.87 (5.50); head length 2.84 to 3.18 (3.07); depth of caudal peduncle 20.60 to 27.00 (23.30). Measurement divided into head length: snout length 3.18 to 3.75 (3.37); eye diameter 4.15 to 5.15 (4.66); interorbital width 9.30 to 14.05 (11 13); upper jaw length 2.54 to 3.29 (2.91); pectoral fin length 1.88 to 2.75 (2.33); pelvic fin length 1.32 to 1.65 (1.46); dorsal first spine 11.80 to 29.90 (18.05); dorsal second spine 2.10 to 3,03 (2.46); dorsal first soft ray 2.77 to 3.85 (3.51); dorsal second soft ray 2.39 to 3.75 (2.69).

Color in preservative: back and sides greyish brown with 5 indefinite broad bars of dusky, which generally becoming fainter with growth of the fish. Under side uniformly pale. In small specimens back and sides with numerous small roundish spots of dusky (Fig. 32), which change rather remarkably both in number

and size during growth of fish. In specimens taken from the East China Sea and off Nobeoka, Miyazaki Prefecture the spots smaller and fewer in larger specimens, and the spots entirely absent on posterior part of body in specimens larger than about 380 mm in total length (Fig. 33 B). On the other hand, in specimens taken from Japanese waters other than Nobeoka the spots generally larger in larger specimens and never disappear on posterior part of body.

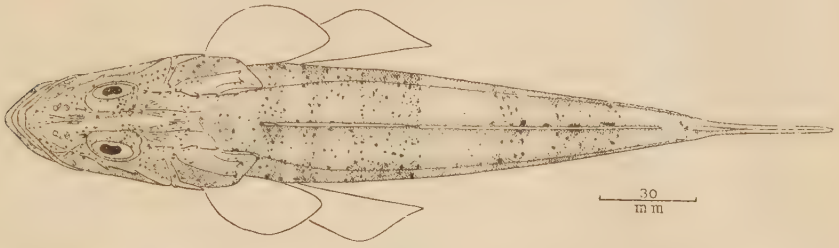

Fig. 32. Upper view of a young specimen (No. 14476) of *Cociella crocodila* taken from Onomichi, Hiroshima Pref., measuring 224.0 mm. in standard length (257.0 mm. in total length). Drawn by K. MATSUBARA.

Remarks.—Not having examined specimens of *Inegocia guttata*, JORDAN and RICHARDSON (1908a, p. 638) synonymized it with the present species without giving any sound basis for their action. The present species, however, is sharply distinguished from *Inegocia guttata*, not only in the generic features aforementioned and contrasted in items 12a and 12b of the analytical key, but also in having fewer number of pectoral fin rays (19 to 21 as compared to 21 to 22 in the latter), shorter snout (snout is 3.2 to 3.8 times into head length as compared to 2.9 to 3.1 in the latter), larger eye (eye diameter is contained 4.2 to 5.2 times into head length, whereas it is 5.3 to 6.0 in the latter), and different coloration.

The present species is one of the valuable food fishes in Japan and abundant throughout southern Japan and the East China Sea. It is widely distributed in the sea between that part of Japan with Tokyo on the Pacific and Niigata on the Japan Sea in the north and the Melanesia, the Micronesia, Queensland, and Natal in the south.

Genus *Kumococius*, new

Genotype. ——*Insidiator detrusus* JORDAN and SEALE.

Ocular cirrus absent; iris lappet simple, semicircular, neither bilobed nor cirrose (Fig. 2, B). Anterior nostril not fringed with a dermal flap (Plate 1). Interopercular flap pointed, prolonged into a bayonet-shape (Fig. 3, A). Scales moderately large; pored scales in lateral line 50 to 60, and they agree exactly with transverse rows of scales running obliquely backward and downward, but much fewer than those running obliquely forward and downward (Table 1). Scales in lateral line

quadrate and the anteriormost 1 or 2 scales spined; the perforating duct slender, and communicated with exterior through end of a single slender tube (Fig. 5, G). Posterior margin of pectoral fin slightly concave; dorsal second spine much shorter than third spine (Plate 1).

Teeth either villiform or granular, in broad band on jaws, vomer and pharyngeals, but in narrow band on palatines; vomerine teeth in 2 parallel longitudinal bands (Figs. 7, E; 8, G; 9, D; 10, C; 11, D: 12, H). Gill-rakers on first arch 2+6 to 9=8 to 11 (Table 2); discal tubercles on the arch very small, uniserial, and interpolated between gill-rakers (Fig. 13, A). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; preorbital and suborbital bones not granulated, but a pungent spine on upper surface of both preorbital and first suborbital bones and about 3 similar spines on second suborbital bone; first suborbital bone broadly overlapping above anterior part of second suborbital bone; hindmost branch of suborbital sensory orgah from central part of preorbital bone not bridged over on posterior part of the bone (Figs. 15, E; 16, C). Hyomandibular process and metapterygoid lamina long, forming a distinct interosseous space between them, two-thirds of which covered with posterior part of metapterygoid bone; posterior half of metapterygoid bone turned outward. 3 preopercular spines, the uppermost one especially enlarged into a bayonet-shape, and the lowermost one rudimentary; no antrorse preopercular spine; a sharp spine at base of uppermost preopercular spine. 2 opercular spines, each preceded by a stout keel. Preopercular sensory canal slender, widely opens between first branch and upper insertion of this organ; branches of the organ long (Figs. 17, E; 19, E; 20, B). Glossohyal becomes strongly wider anteriorly in fan-like fashion, the posterior margin deeply concave; the bone shallowly invested in muscle of isthmus, and lower aspect of the bone shallowly concave between latelal keels (Fig. 22, I). Cranium graunlated and armed with spines; postorbital part of cranium much wider than long, and much shorter than twice diameter of orbit; supraorbital rim of frontal bone elevated, armed with a series of spinous ridge; horny process from posterior margin of opisthotic bone well developed, extending posteriorly beyond rear end of parietal bone; ventral process of basisphenoid well developed, the tip meeting parasphenoid (Fig. 24, D). Uppet lamina of clavicle covers anterior half of coracoids (Fig. 26, E). Postpelvic process simple, bluntly pointed; postpelvic and subpelvic keels simple, with roundish outer margin; suprapelvic keel forming an obtuse angle at upper anterior extremity (Fig. 28, A).

Remarks.—We erect this new genus for *Insidiator detrusus* JORDAN and SEALE because this species, alone among all members of the Platycephalidae, lacks any trace of the anterior nasal flap and the posterior margin of the pectoral fin is shallowly concave, instead of being roundish (see item 11b of the analytical key, cont-

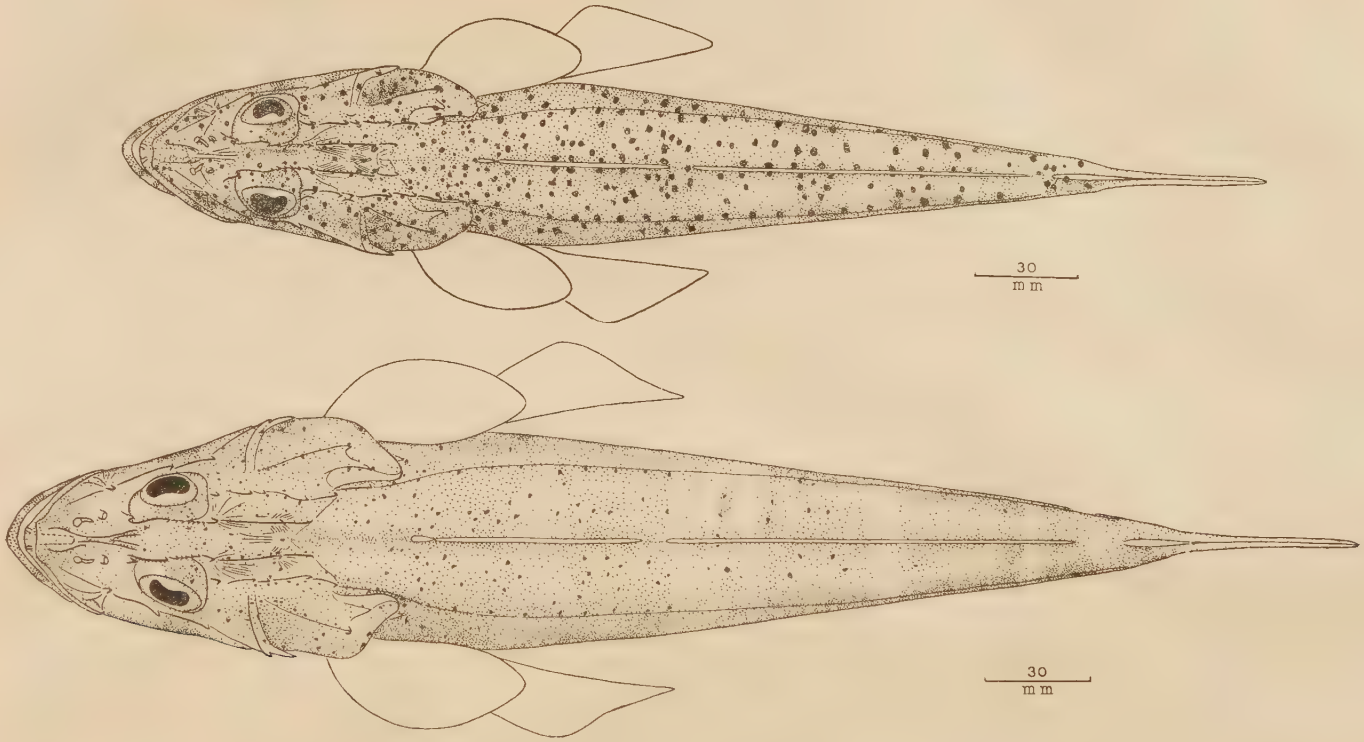

Fig. 33. Variation of color-pattern in adult of *Cociella crocodila*. A, From a specimen (No. 11105) taken from Kanaiwa, Ishikawa Prefecture, measuring 285.0 mm. in standard length (330,0 mm. in total length); B, from a specimen (No. 12170) taken from East China Sea, measuring 340 mm. in standard length (386.5 mm. in total lenth). Drawn by K. MATSUBARA.

rasted with item 11a). Yet the present genus is closely related to the *Inegocia* and *Cociella*, from which it differs in characteristics contrasted in items 11a and 11b, and in items 12a and 12b.

Kumococius detrusus (JORDAN and SEALE)
Kumo-gochi (named by KAMOHARA)
Pl. II.

Insidiator detrusus JORDAN and SEALE, 1905, p. 15, pl. 10, Hong Kong (original description). —— HERRE, 1944a, p. 33, Hong Kong (listed).

Thysanophrys sculptus (erroneous identification) KAMOHARA, 1952, p. 106, Urado and Mimase, Shikoku (diagnosis).

Mrterial described.——Nos. 15496–15518, 15522, 15539–15559, and 15758 (MATSUBARA's Fish Collection), 75.0–128.0 mm. in standard length (91.0–255.0 mm. in total length), Urado, Shikoku, February 20, 1951.

Description.—The counts and measurements (followed by averages in parentheses) of these 46 specimens run as follows:

Dorsal spines 1, 8 (1, 8); dorsal soft rays 11 (11); anal fin rays 12 (12); pectoral fin rays 18 to 20 (19.35). Gill-rakers on first arch 2+6 to 9=8 to 11 (9.77). Pored scales in lateral line 46 to 55 (52). Pyloric coeca 7 (7). Measurement divided into standard length: greatest body depth 5.82 to 8.92 (6.93); greatest body width 4.30 to 5.43 (4.81); head length 2.74 to 3.04 (2,89); depth of caudal peduncle 15.50 to 21.20 (17.60). Measurement divided into head length: snout length 2.59 to 4.10 (3.17); eye diameter 3.23 to 5.05 (3.96); interorbital width 12.30 to 20.00 (14.90); upper jaw length 2.44 to 3.28 (2.70); pectoral fin length 1.67 to 2.26 (1.82); pelvic fin length 1.40 to 1.76 (1.53); dorsal first spine 11.40 to 23.20 (15.25); dorsal second spine 3.06 to 5.23 (3.70); dorsal first soft ray 2.27 to 3.94(2,64); dorsal second soft ray 2.00 to 2.78 (2.32).

Head greatly depressed and moderately large, about twice as broad as high at base of uppermost preopercular spine and usually a little larger than one-third the length of body (without caudal). Top and sides of head moderately armed with spines and fine ridges; supercilliary ridges elevated, each armed with 3 to 7 spines; in front of each ridge a sharp preocular spine present. A row of about 5 spines from posterior edge of orbit to origin of lateral line, the last 2 of them on scapular ridge. Parietoccipital region with a pair of low ridge, each terminating a stout spine. Infraorbital ridge armed with a series of about 6 sharp backward-directed spines, the anteriormost one below posterior nostril at central part of preorbital bone and the last one just in front of base of uppermost preopercular spine. A pair of very small nasal spine on middle of snout. 3 preopercular spines, the uppermost one especially enlarged into a bayonet-shape, about two-thirds as long as eye diameter, extending as far beyond opercular margin; the last one rudimentary. 2 opercular spines, pungent, each preceded by a smooth keel.

Snout always longer than eye diameter. Eye rather large, the diameter slightly more than 3 times as long as interorbital width; iris lappet simple, semicircular in shape, neither bilobed nor cirrose; interorbital region slightly concave. Nostrils, 2 on each side, opening on top of low nasal tube, none of them fringed with a dermal flap. Mouth moderately large; maxillary extends slightly beyond anterior orbital rim; rear margin of maxillary deeply concave and upper half of the bone hidden under preorbital bones. Lower jaw strongly projects beyond the upper in closed mouth. Tongue very broad, fan-like in shape, the anterior margin emarginate, with a slight median convexity. Teeth either villiform or granular, in broad band on jaws, vomer and pharyngeals, but in narrow band on palatines. Interopercular flap pointed, much longer than wide, and prolonged into a bayonet-shape (Fig. 3, A and plate 1).

Gill-rakers long, stout and bluntly pointed at the tip, their inner surfaces thickly covered with spinules; discal tubercles on the arch very small, uniserial, and interpolated between gill-rakers (Fig. 13, A).

Dorsal inserted directly above base of pelvic fin; spinous and soft dorsals of about equal height, but the former slightly shorter than the latter; dorsal second spine much shorter than the third or fourth spine; dorsal fourth spine the longest, about as long as dorsal second soft ray. Anal fin inserted below base of dorsal third soft ray, the base slightly longer than that of second dorsal fin. Caudal fin rounded. Pectoral fin broad, the lower 6 rays simple; the fin reaches below base of dorsal seventh or eighth spine; posterior margin of the fin slightly concave. Pelvic fin longer than pectoral fin, reaching posteriorly as far origin of anal fin.

Scales moderately large; anteriormost 1 or 2 lateral line scales spined; head naked except for opercle and postorbital region; fins naked except for basal part of caudal fin,

Color, in preservative, yellowish brown above and sides, whitish below; 5 very indefinite but broad bars of dusky on back and sides of body, the first one before first dorsal, the second one below middle of first dorsal, the third one below interspace between dorsals, the fourth one below posterior half of second dorsal, and the last one on caudal peduncle. Head also yellowish brown, the anterior half of operculum, however, dark brown. First dorsal fin more or less dusky, with a jet black blotch on distal part between second and third spines and a similar one between fourth and fifth one; posterior margin of the fin blackish. Second dorsal pale, but the distal margin more or less dusky, Distal half of anal fin slightly dusky with whitish margin. Caudal fin with a dusky wash on posterior half. Pectoral fin pale gray, broadly surrounded with blackish brown. Pelvic fin dusky.

Remarks.—It is worthy of a special mention that *Insidiator detrusus* shown in JORDAN and SEALES' figure (1905, pl. 10) has the anterior nasal flap and lacks the interopercular flap. Our specimens amounting to 46 in number are, on the

contrary, all lacking the anterior nasal flap and provided with an interopercular flap. We are inclined to regard these discrepancies between their figure and our specimens as draughtsman's mistake.

The present species appears to be more akin to *Platycephalus sculptus* of GÜNTHER (1880, p. 41, pl. 17, fig. A) than to any other species of the flatheads, but it is clearly distinguished from the latter in having much fewer scales in the lateral line (46 to 55 as compared to 70 in the latter), nearly smooth lateral line scales (anterior half of lateral line scales are spined in the latter), much narrower interorbital space (the space is about one-third as broad as the vertical diameter of the eye instead of being one-half in the latter), and in lacking the anterior nasal flap.

Genus *Ratabulus* JORDAN and HUBBS

Ratabulus JORDAN and HUBBS, 1925, p. 286 (type by original designation *Thysanophrys megacephalus* TANAKA).

Ocular cirrus absent; iris lappet scarcely developed, simple, neither bilobed nor cirrose (Fig. 2, A). Anterior nostril fringed with a dermal flap posteriorly. Interopercular flap absent (Fig. 3, I). Scales small; pored scales in lateral line 50 to 55, and they much fewer than transverse rows of scales running obliquely either backward and downward (71 to 80) or forward and downward (95 to 105) (Table 1); scales in lateral line rectangular in shape, the first several scales spined; perforating duct of lateral line scales slender, communicated with exterior through end of a single slender tube (Fig. 5 I). Dorsal last spine minute, entirely free from the preceding one; caudal fin truncated.

Teeth highly specialized, in band on jaws, vomer, palatines and pharyngeals, some of them canine-like and even depressible (Figs. 6,B; 8,B; 9,B; 10,J; 11,B; 12,E). Gill-rakers on first arch about $1+7=8$; discal tubercles on the arch small, irregularly biserial, those of the inner series interpolated between gill-rakers, but those on the outer series extending along outer side of base of gill-rakers (Fig. 13, G). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; preorbital and suborbital bones not granulated, but a sharp spine at central part of preorbital bone, 2 or 3 similar ones on first suborbital bone, and a larger one and about 4 much smaller ones on second suborbital bone; upper anterior arm of preorbital bone produced into a long conical process, and lower anterior arm of this bone armed with 2 stout antrorse process; first suborbital bone overlapping above anterior part of second suborbital bone; hindmost branch of suborbital sensory organ from preorbital bone not bridged over on posterior part of the bone (Figs. 15,I; 16,C). Hyomandibular process and metapterygoid lamina well developed, forming a moderately large interosseous space between them, which entirely covered with posterior part of metapterygoid bone; posterior half of

metapterygoid bone turned outward. 3 preopercular spines, the uppermost one prolonged into a bayonet-shape, the lowermost one rudimentary; no antrorse preopercular spine; an accessory spine at base of uppermost preopercular spine. 2 opercular spines, each preceded by a stout keel. Preopercular sensory canal slender, widely opens between first branch and upper insertion of the organ; insertion of the organ simple; branches of the organ slender (Figs. 17, I; 19, F). Glossohyal rectangular, deeply concave along both lateral and posterior margins. Urohyal strengthened by 2 pairs of lateral keels in addition to a median stout keel; the bone widest at about posterior one-third of the entire length, and the posterior margin deeply concave; the bone shallowly invested in muscle of isthmus, and lower aspect of the bone shallowly concave (Fig. 22, H). Cranium not granulated, but strongly spined; postorbital part of cranium much longer than wide, but much shorter than twice diameter of orbit; supraorbital rim of frontal bone elevated, armed with a series of spinous ridge; horny process from posterior margin of opisthotic bone well developed, extending posteriorly far beyond rear end of parietal bone; ventral process of basisphenoid rudimentary, the tip never in contact with parasphenoid (Fig. 25, D). Upper lamina of clavicle covers anterior half of coracoids (Fig. 26, I). Postpelvic process bicuspid; postpelvic and subpelvic keels simple, with roundish outer margin; suprapelvic keel forming an obtuse angle at upper anterior extremity (Fig. 29 A).

Remarks.—The present genus is distinguished from all other genera of *Onigocia*-stem in 1) teeth are highly specialized, some of them canine-like and even depressible, 2) the last dorsrl spine is minute and free from the preceding one, 3) the candal fin is truncated, 4) the urohyal bone is strengthened by 2 pairs of lateral keels in addition to a median stout keel, 5) the interosseous space between the hyomandibular process and metapterygoid lamina is entirely covered with posterior part of the metapterygoid bone, and 6) postpelvic process is bicuspid.

It should be mentioned that the present genus is related to the *Platycephalus* in several peculialities such as: 1) the dorsal last spine is entirely free from the preceding one, 2) the postpelvic process is bicuspid, and 3) the interosseous space between hyomandibular process and metapterygoid lamina is entirely covered with posterior part of metapterygoid bone.

Ratabulus megacephalus (Tanaka)

Pl. III

Thysanophrys megacephalus Tanaka, 1917, p. 9, Tokyo market (original description). ——Tanaka, 1931, p. 37 (listed).——Kamohara, 1952, p. 70, Prov. Tosa (notes).

Ratabulus megacephalus Jordan and Hubbs, 1925, p. 287, Kagoshima Bay (translation of Tanaka's original description of *Thysanophrys megacephalus* published in Japanese). ——Okada and Matsubara, 1938, p. 334 (key; distribution).——Mori, 1952, p. 159, Tongyong, Korea (listed).

Material described.——No. 6644 (Matsubara's Fish Collection), 255.0 mm. in standard length (300.0 mm. in total length), off Kasumi, Hyôgo Pref., December 5, 1943.——Nos. 10113, 10122–10123,

and 10129, 110.0–157.0 mm. (134.0–190.0 mm.), off Maisaka, Shizuoka Pref., February, 1948. ——No. 12168, 279.0 mm. 323.0 mm.), East China Sea, February, 1949.——Nos. 15001–15007, 15009–15014, and 15128, 182.0–262.0 mm. (212.0–306.0 mm.), off Owashi, Kumano-nada, January 5–10, 1950. ——Nos. 15568–15570, 133.0–259.0 mm. (155.5–305.0 mm.), Urado, Kochi Pref., February 20–28, 1951.——Nos. 14957–14960, 200.0–305.5 mm. (234.0–350.0 mm.), Maisaka, Shizuoka Pref.

Description.—Of this rare species we obtained 27 specimens, the following description may serve to supplement the briefly described original description.

Dorsal spines 1, 8, 1(1, 8, 1); dorsal soft rays 11 (11); anal fin rays 11 or 12 (11.95); pectoral fin rays 19 or 20 (19.60). Gill-rakers on first arch 1+6 to 8=7 to 9 (7.95). Pored scales in lateral line 47 to 54 (49.70). Pyloric coeca 5 (5). Measurement divided into standard length; greatest body depth 7.50 to 12.10 (9.05); greatest body width 5.33 to 6.40 (5.77); head length 2.33 to 2.79 (2.66); depth of caudal peduncle 19.60 to 25.80 (22.10). Measurement divided into head length: snout length 2.70 to 3.40 (2.95); eye diameter 4.74 to 5.45 (5.13); interorbital width 12.60 to 17.00 (15.35); upper jaw length 2.54 to 2.81 (2.71); pectoral fin length 2.25 to 2.85 (2.45); pelvic fin length 1.63 to 2.08 (1.85); dorsal first spine 22.80 to 64.70 (39.50); dorsal second spine 2.74 to 3.96 (3.39); dorsal first soft ray 3.59 to 4.91 (4.06); dorsal second soft ray 2.55 to 2.93 (2.75).

Head very large, slightly less than twice as long as broad and always much longer than one-third as long as standard length of body. Top and sides of head roughened with spines and armed with fine smooth ridges; supercilliary ridge elevated, armed with a series of small but stout backward-directed spines on posterior half of eye; a stout backward-directed preocular spine in front of eye; a row of 5 similar spines from posterior part of eye to origin of lateral line, the last 2 of them, much larger than the others, on scapular ridge. A pair of short ridge on parietoccipital region, each armed with a single elevated spine at the middle part. Infraorbital keel armed with a series of backward-directed spines, the anteriormost one at central part of preorbital region, the next 2 or 3 ones below middle of eye, a large one, which preceded by 3 or 4 much smaller ones, below hind edge of eye, about 4 small ones on cheek, and a last one immediately in front of uppermost preopercular spine. No nasal spine. Lower anterior margin of preorbital bone with 2 blunt antrorse processes. 3 preopercular spines, the uppermost one much larger than the others, the lowermost one very small, immediately below middle one. 2 sharp opercular spines, each preceded by a smooth keel.

Snout rather long, but much less than twice diameter of eye. Eye very large, about 3 times as long as interorbital width; iris lappet small, simple and never cirrose (Fig. 2, A); interorbital region moderately concave, armed with a pair of posteriorly diverged longitudinal keels on each side of the median line, forming a rather deep channel between them. Nostrils, 2 on each side, opening on top of raised rim, the anterior one fringed with a rather large blunt dermal flap posteriorly; posterior

nostril with a entire rim. Maxillary extends slightly beyond a vertical through front edge of orbit; upper half of maxillary hidden under preorbital bones. Lower jaw projecting beyond upper in closed mouth by a distance equal to two-thirds interorbital width. Tongue very broad, fan-like in shape, the anterior margin broadly but shallowly concave, without a median convexity. Teeth in broad band on upper jaw, palatines and pharyngeals, in 3 or 4 series on lower jaw, and in about 3 series on vomer; teeth of upper jaw canine-like and even depressible at anterior part of the band and middle part of the innermost series (Fig. 6, B); those of low jaw granular except for depressible canines on the innermost series (Fig. 8, B); vomerine teeth rather few, depressible and all canine-like (Fig. 9, B); palatine teeth canine-like and depressible anteriorly, but villiform posteriorly (Fig. 10, J); pharyngeal teeth mostly enlarged into canines (Fig, 10,B; 12,E). Interopercular flap entirely absent (Fig. 3,I).

Gill-rakers on first arch 1+6 to 8=7 to 9, but mostly 1+7=8 (Table 2); the rakers long, stout and blunt at their tips, their inner surfaces thickly covered with sharp spinules; discal tubercles on the arch small, flattish, thickly covered with similar spinules.

Dorsal begins above base of pelvic fin; the second to fourth spines subequal in length and about as long as dorsal second soft ray; base of first dorsal fin slightly shorter than that of second dorsal fin; first, ninth and tenth spines of dorsal minute, the last one of them free from the preceding one and hardly visible with naked eye. Anal fin, lower and but little longer than second dorsal, begins from a vertical through base of dorsal third soft ray. Caudal distinctly truncated. Pectoral fin broad, round, the lower 6 or 7 rays simple and more or less thickened; the fin extends below base of sixth or seventh dorsal spine. Pelvic fin, much longer than pectoral fin, extends posteriorly as far vent or a little beyond.

Scales small and adhesive; first 2 or 3 scales in lateral line spined; perforating duct of lateral line scales slender, about 3 times as long as broad, and communicated with exterior through end of a lower slender tube (Fig. 5, I). Postorbital region of head, occipital region and operculum scaly, but other parts of head naked. Fins naked except for basal part of caudal fin, where small scales crowded.

Color, in preservative, brown or grayish brown above and sides, whitish below; back and side of body, inclusive of head, specked with darker and crossed with about 8 ill-defined broad bars of darker; the first band on top of head between eyes, extending to suborbital region across eye; the second one across occiput and reaches below to base of uppermost preopercular spine; the third one in front of first dorsal fin; the fourth one below insertion of first dorsal fin; the fifth one below posterior half of first dorsal; the sixth one below middle of second dorsal fin; the seventh one below posterior part of second dorsal fin; and the last one on caudal peduncle. Premaxillary and lower lip crossed with bars of dusky. Posterior one-third of first dorsal fin dark brown, but other parts of the fin pale and specked with dusky.

Second dorsal, caudal and pelvic fins pale, with dark spots; anal fin uniformly pale. Pectoral fin rays with spots of dusky, forming about 6 rather distinct cross bars.

Remarks.—Our specimens thus far examined stand at variance in description with TANAKA's *Thysanophrys megacephalus* in having longer upper jaw (upper jaw length is about 2.25 to 2.85 in head length as compared to 3.33 in the latter) and larger number of dorsal spines (10 instead of being 9 in the latter). And yet the agreement of our specimens with it in other important features is so obvious as to lead one to refer our specimens to the present species. It is highly probable that the last free minute dorsal spine has been overlooked by TANAKA.

Genus *Platycephalus* BLOCH

Platycephalus BLOCH, 1795, p. 96 (type by original designation *Platycephalus spathula* BLOCH, = *Callionymus indicus* LINNAEUS).
Calliomorus LACÉPÈDE, 1880, p. 343 (type by original designation *Callionymus indicus* LINNAEUS).

Head broad and extremely depressed, being smooth or scarcely armed. Ocular cirrus absent; iris lappet simple, very narrow and bluntly pointed, neither bilobed nor cirrose (Fig. 2, D). Anterior nostril fringed with a dermal flap posteriorly. Interopercular flap V-shaped, much broader than long and bluntly pointed, but usually absent in young specimens smaller than 300 mm. in standard length in Japanese species (Fig. 3, C). Scales very small; pored scales in lateral line 60 to 70, and they much fewer than transverse rows of scales running obliquely either backward and downward (104 to 112) or forward and downward (121 to 137) (Table 1). Scales in lateral line rectangular in shape and all smooth; the perforating duct slender and communicated with exterior through end of a single tube (Fig. 5, J). Dorsal first 2 spines minute, the anteriormost one hardly visible with naked eye; dorsal last spine also minute, free from the preceding one.

Teeth mostly villiform or granular, some of them enlarged; vomerine teeth studded in a crescentic band, placed nearly transversely to shaft of the bone, several teeth of the innermost series enlarged; teeth on upper jaw in broad band, some at anterior part of the innermost series enlarged into a bayonet-shape; teeth on lower jaw in 2 or 3 series, those of the innermost series large and stout; palatine teeth in 2 series, those of the outer series minute, but the other ones enlarged; outer posterior part of lower pharyngeal bone produced into a long lobe, which about as long as the rest of the bone (Figs. 6,A; 8,A; 9,A; 10,A; 11,A; 12,I). Gill-rakers on first arch 2 to 3+6 to 9=8 to 12 (Table 2). Discal tubercles on the arch small, set irregularly in 2 series; those of inner series rudimentary and irregular in arrangement, usually absent between gill-rakers near angle of the arch; those of outer series run along base of gill-lamellae (Fig. 13, H). Lower half of second suborbital bone below median longitudinal keel never turned inward, and lower margin of this bone exposed as a longitudinal keel on side of head, thus, side of head bicarinate; preorbital and suborbital

bones entirely smooth except for a blunt tubercle on anterior part of second suborbital bone; third suborbital bone held at anterior one-fourth of upper border of second suborbital bone; upper anterior arm of preorbital bone produced into a long conical process; lower anterior margin of preorbital bone with 2 stout antrorse processes; first suborbital bone broadly overlapping adobe anterior part of second suborbital bone; hindmost branch of suborbital sensory canal from preorbital bone bridged over on posterior part of this bone, and gives off a branch at anterior one-third of second suborbital bone, then runs upward and forward, instead of vertically upward in other species, until it reaches to third suborbital bone (Figs. 15,J; 16,B). Hyomandibular process and metapterygoid lamina indistinct, and interosseous space between them entirely covered with posterior part of metapterygoid bone; upper half of metapterygoid bone turned outward. Preopercular spines 2, stout, subequal or the lower one even longer than the upper; no accessory spine at base of upper preopercular spine; no antrorse preopercular spine. Opercular spines 2, the lower one not preceded by a keel. Preopercular sensory canal slender, widely opens between the first branch and upper insertion of the organ; upper insertion of the organ simple; branches of the organ slender (Figs. 17,J; 19,J). Glossohyal becomes strongly wider anteriorly in fan-like fashion, narrowest at posterior one-fifth of the bone, and rear margin of the bone strongly convex, forming 3 distinct condyles. Urohyal widest at about posterior one-third of the bone, and the posterior margin deeply concave; the bone shallowly invested in muscle of isthmus and lower surface of the bone shallowly concave (Fig. 22, J). Cranium neither spined nor granulated; postorbital region of cranium much longer than wide and about 3 times as long as diameter of orbit; postorbital rim formed by frontal and sphenotic bones extends forward far beyond a vertical through anterior margin of prootic bone; sphenotic bone about 3 times as long as broad; supraorbital rim of frontal bone little elevated, smooth, and supraorbital spinous ridge deprived of its normal position and located behind interorbital region; vomer strongly dilated outward anteriorly, and mesethmoid-vomerine keel on upper surface of these bones feebly developed; lower surface of both vomer and parasphenoid wide and flattish; window between orbits lying in front of basisphenoid very small; opisthotic bone bearing no horny process posteriorly; ventral process of basisphenoid slender, but the tip free from parasphenoid (Fig. 25, E). Upper lamina of clavicle covers nearly entire surface of coracoids; upper surface of clavicle highly keeled; lower lamina of clavicle never especially produced backward immediately below quadrangular part of hypocoracoid (Fig. 26, J). Postpelvic process tricuspid; postpelvic keel with a spinous process which directed inward and backward; subpelvic keel bearing a falciform process which directed forward and slightly inward; suprapelvic keel forming an obtuse angle at anterior extremity (Fig. 29, B).

Remarks.—The present genus is sharply distinguished from other Japanese genera of this family by many features, such as: 1) the head is extremely depressed,

being smooth or scarcely armed, 2) preopercular spines are usually 2, enlarged and subequal or the lower one even larger, 3) accessory spine is absent at base of upper preopercular spine, 4) the lower opercular spine is not preceded by a bony keel, 5) pored scales in lateral line are greater than 60 and all spineless, 6) dorsal first 2 spines minute, the anteriormost one is rudimentary and hardly visible with the naked eye; the dorsal last spine is also minute, and entirely free from the preceding one, 7) vomerine teeth are studded in a crescentic band and placed nearly transversely to the shaft of the bone, 8) outer posterior part of the lower pharyngeal bone is produced into a long lobe, which is about as long as the rest of the bone, 9) the third suborbital bone is held at anterior one-fourth of upper border of the second suborbital bone instead of being nearly middle of it in the others, 10) hindmost barnch of the suborbital sensory canal from the preorbital bone turns upward and forward, instead of being vertically upward, at anterior one-third of the second suborbital bone, 11) the hyomandibular process and metapterygoid lamina are indistinct, and the interosseous space between them is entirely covered with posterior part of the metapterygoid bone, 12) upper half of the metapterygoid bone is turned outward, 13) rear margin of the glossohyal bone is roundly convex, forming 3 distinct condyles, 14) postorbital part of the cranium is about 3 times as long as the diameter of orbit, 15) postorbital rim formed by the frontal and sphenotic bones extends forward far beyond a vertical through anterior margin of the prootic bone, 16) the sphenotic bone is about 3 times as long as wide, 17) supraorbital rim of the frontal bone is little elevated, smooth and the supraorbital spinous ridge is deprived of its normal position and located behind the interorbital region, 18) the vomer is strongly dilated outward anteriorly, and the mesethmoid-vomerine keel on upper surface of these bones is feebly developed, 19) lower surface of both vomer and parasphenoid is wide and flattish, 20) the window between orbits in front of the parasphenoid is very small, 21) the opisthotic bone is bearing no horny process posteriorly, 22) upper lamina of the clavicle covers nearly entire surface of the coracoids, 23) upper surface of the clavicle is highly keeled, aud 24) the postpelvic process is tricuspid, the postpelvic keel bears a conspicuous spinous process, and subpelvic keel is armed with a falciform process.

Platycephalus indicus (Linnaeus)

Callionymus indicus Linnaeus, 1758, p. 250, Asia (original description).
Cottus insiaiator Forskål, 1775, p. x, Red Sea (original description).
Calliomorus indicus Lacépède, 1800, p. 343.
Platycephalus insidiator Cuvier and Valenciennes, 1829, p. 227, Pondicherry; Moluccas (description). ——Temminck and Schlegel, 1842, p. 39, pl. 15, fig. 1, Nagasaki (description). ——Richardson, 1846, p. 216, Canton (synonymy; notes; distribution).——Cantor, 1849, (1950), p. 1019, Penang.——Brevoort, 1856, p. 260, Yedo Bay (notes). ——Günther, 1860, p. 177, Ganges; Calcutta; Japan; China; Ceylon; Malay Peninsula; Moluccas; Amboyna; Cape York; West Australia; N. W. Australia; Red Sea; Port Natal; Cape of Good Hope (description). ——Playfair and Günther, 1866,

p. 49, Aden; Zanzibar (synonymy; distribution).——Day, 1878–1888, p. 276 (description).——Günther, 1879, p. 66, Yokohama Bay; Inland Sea of Japan (listed).——Nyström, 1887, p. 25, Nagasaki, (notes) ——Steindachner and Döderlein, 1887, p. 259, Tokyo; Kôchi; Kagoshima (notes).——Day, 1889, p. 237 (description).——Rutter, 1897, p. 83. Swatow, China, after Sauvage (synonymy; notes).—— Dunker, 1903 (1904), p. 153, Singapore.——Jordan and Seale, 1905a, p. 15, Hong Kong (diagnosis). ——Jordan and Seale. 1905b, p. 794, Island of Negros, Philippines (listed).——Jordan and Seale, 1906, p. 510, Manila (diagnosis). ——Jordan and Starks, 1906, p. 522, Port Arthur, Manchuria (notes).——Evermann and Seale, 1907, p. 103, San Fabian, Philippines (synonymy).——Jordan and Seale, 1907, p. 38, Cavite, Philippines (diagnosis). ——Seale, 1914, p. 77, Hong Kong markets (notes).——? Herre and Myers, 1931, p. 252, Hong Kong (notes). ——Borodin, 1932, p. 91, Brisbane, Queensland (listed). ——Suvatti, 1936, p. 146, Canthaburi River; Gulf of Siam (notes). —— Hardenberg, 1937, p. 12, mouth of the Kumai River, S. W. Borneo (listed). ——? Roxas and Martin, 1937, P. 182 (distributional record in Philippines).——Boeseman, 1947, p. 48 (revision of *Platycephalus insidiator* of Temminck and Schlegel).

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Material described.——Nos. 14462–14467 and 14471–14474 (Matsubara's Fish Collection), 190.0–362.0 mm. in standard length (216.0–405.5 mm. in total length), Onomichi, Hiroshima Pref., November 10, 1950. ——No. 14569, 406.0 mm. (459.0 mm.), Nobeoka, Miyazaki Pref., November 12, 1950.——No- 14726, 407.0 mm. (460.0 mm.), East China Sea, November 6, 1950.

Description.—The counts and measurements (followed by averages in parentheses) of these 12 specimens run as follows: Dorsal spines 2, 7, 1 (2, 7, 1); dorsal soft rays 13 (13); anal fin rays 13 (13); pectoral fin rays 18 or 19 (18.75). Gill-rakers on first arch 2 to 3+6 to 9=8 to 12 (10.45). Pored scales in lateral line 62 to 69 (66.70). Pyloric coeca 10 (10). Measurement divided into standard length: greatest body depth 8.84 to 11.50 (9.99); greatest body width 3.44 to 5.30 (4.93); head length 3.24 to 3.54 (3.37); depth of caudal peduncle 23.00 to 29.20 (20.06). Measurement divided into head length: snout length 3.68 to 4.27 (3.91); eye diameter 6.93 to 8.65 (7.92); interorbital width 5.40 to 7.60 (6.18); upper jaw length 2.67 to 3.20 (3.01); pectoral fin length 2.00 to 2.61 (2.22); pelvic fin length 1.35 to 1.56 (1.47); dorsal first spine 59.00 to 100.80 (77.56); dorsal second spine 12.70 to 30.30 (21.36); dorsal third spine 2.07 to 2.84 (2.37); dorsal first soft ray 2.18 to 2.90 (2.46); dorsal second soft ray 2.25 to 2.73 (2.40).

Remarks.—In our specimens the anteriormost dorsal spine is rudimentary and can hardly be seen with the naked eye; the last dorsal spine is also minute, and entirely free from the preceding one. These spines have hitherto been overlooked.

This species is widely distributed from the Red Sea and Natal, South Africa, to New Guinea and Queensland, and north to Japan with Kominato on the Pacific and Niigata on the Japan Sea.

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(Asterisks mark those to which we did not gain access.)

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Explanation of plates

Plate I. Lateral view of an adult specimen (No. 14342) of *Inegocia guttatta* (CUVIER and VALENCIENNES) taken from Maizuru, Kyoto Pref., measuring 277.0 mm. in standard length (334.0 mm. in total length). Drawn by K. MATSUBARA.

Plate II. Lateral view of an adult specimen (No. 15540) of *Kumococius detrusus* (JORDAN and SEALE) taken from Urado, Shikoku, measuring 148.5 mm. in standard length (181.0 mm. in total length). Drawn by K. MATSUBARA

Plate III. Lateral view of an adult specimen (No. 14960) of *Ratabulus megacephalus* (TANAKA) taken from Maisaka, Shizuoka Pref., measuring 303.5 mm. in standard length (350.0 mm. in total length). Drawn by K. MATSUBARA.

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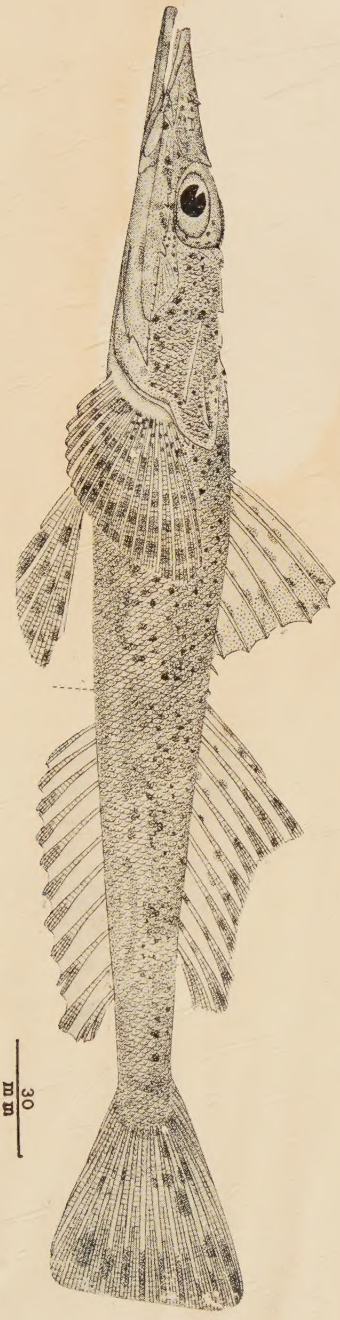
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